THE SILICOFLAGELLATA AND TINTINNOINEA.

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WITH FORTY-THREE TEXT-FIGURES.

CONTENTS.

THE SILICOFLAGELLATA.

Introduction.

SILICOFLAGELLATES are rare in the material of the Great Barrier Reef Expedition. This is to be expected, since their small size enables them to pass through the meshes of even the finest net used, but the numerous water samples centrifuged and examined during the course of the year show that they were actually present only in very small numbers (Marshall, 1933, Vol. II, No. 5). They showed no seasonal variation, but appeared occasionally throughout the year in numbers up to 30 per litre. The specimens figured here are mainly those taken in the international fine silk net (see Russell and Colman, 1931, Vol. II, No. 2, for details of apparatus and position of stations).

Silicoflagellates have long been known from their skeletons, particularly in fossil material, but it is only comparatively recently that much attention has been paid to the protoplasmic body. They were for long considered to belong to the Radiolaria, either as members of the Acanthodesmidae (Haeckel, 1862), or as only parts of the skeleton of Radiolarians (Phaeodarian) (Hertwig, 1879, and Haeckel, 1887). In 1891, however, Borgert, working mainly on *Distephanus speculum*, proved that they were independent organisms. He described the flagellum, and separated them from the Radiolaria, making for them a special group in the Mastigophora. Recently Schulz (1928) and Gemeinhardt (1930) have published monographs on the whole group, and the latter has added considerably to our knowledge of the living form. The observations on living specimens which are given below were made on material from the Clyde sea-area, but, so far as could be ascertained, they are true also of the Great Barrier Reef specimens. Silicoflagellates are very delicate organisms, and do not live for long in the laboratory under any circumstances; conditions on Low Isles were not favourable for their survival.

Anatomy.

The hollow siliceous skeletons of the two living genera *Distephanus* and *Dictyocha* are similar in plan, and can be understood by an examination of Text-fig. 1. There is a basal " ring ", four-sided in the case of *Dictyocha* and six-sided in the case of *Distephanus*, from each angle of which a spine projects radially. From about the middle of each side there rises a supporting bar. In *Dictyocha* the bars from adjacent sides unite and are joined by a central arch; in *Distephanus* the bars support a second, apical " ring ". Small spines are also present, usually one directed abapically on each of the four or six sides of the basal ring, between the radial spine and the supporting bar to the right of it, and often one or more directed apically on the central arch or apical ring.

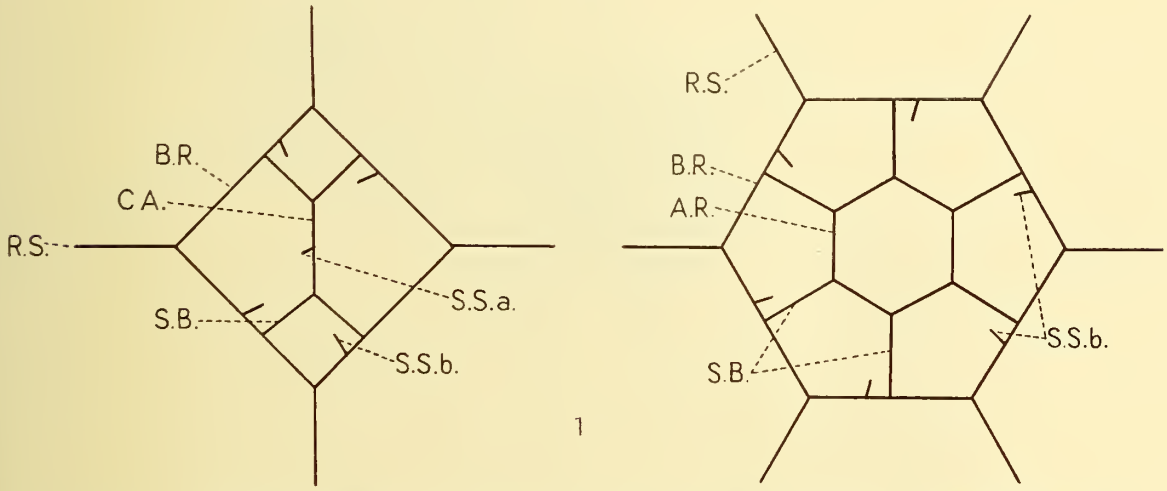
There is a great deal of variation in the form of the skeleton. The radial spines may be long or short, they may be bifid or be absent altogether; one side may be incomplete; in *Dictyocha* the basal ring may be three-, four- or five-sided, and in *Distephanus* four-, five-, six-, seven-, eight- or nine-sided, with all the modifications consequent on this disturbance of the usual arrangement; in *Distephanus* the apical ring may be absent, or it may be divided into two or more. Some of these variations (such as bifid spines or an incomplete side) are obviously mere abnormalities, while some occur so frequently and regularly as to be classed as separate varieties. In several cases the variation seems to take a form transitional between one species and another, or between one genus and another. Schulz and Gemeinhardt have divided the genera *Dictyocha* and *Distephanus* into a small number of species, each with a large number of varieties and forms.

In all the varieties described double specimens occur. These consist of two individuals with their basal rings closely apposed. They hold together firmly and are not easily detached from one another. Borgert considered these to be conjugating forms, but Gemeinhardt has shown that they are really in course of division, and he has described and figured a number of stages in the process. In such pairs the skeleton of one is often much thinner than that of the other. Nuclear division does not take place till the second skeleton is fully formed.

When mounted in canada balsam the hollow interior of the skeleton has a different refractive index from the rest of the skeleton. It looks as if it were filled with air, and

this sometimes makes the examination of the nucleus difficult. Immediately after mounting the skeleton may be quite transparent, but in a short time there is the appearance of a minute bubble in one corner, and this spreads rapidly through the whole cavity of the skeleton. If, however, any part is broken, even the tip of a small spine, this bubble vanishes and the whole skeleton becomes perfectly transparent again. Lemmermann (1901) mentions this difficulty, and says that skeletons, heated on a slide, will fill with air which may be got rid of by means of alcohol, and he suggests that fine pores may be present in the skeleton. The bubble appearance comes, however, even when the specimen has never been allowed to dry. Borgert evaded the difficulty by mounting his specimens in glycerine, by which means he could make it disappear entirely.

An early description of a living Silicoflagellate was that by Johannes Müller in 1855, and it contains the following: "An den frisch beobachteten Exemplaren einer sechsstrahligen *Dictyocha* [now *Distephanus*] war das Kieselnetz von einer gelblichen organischen



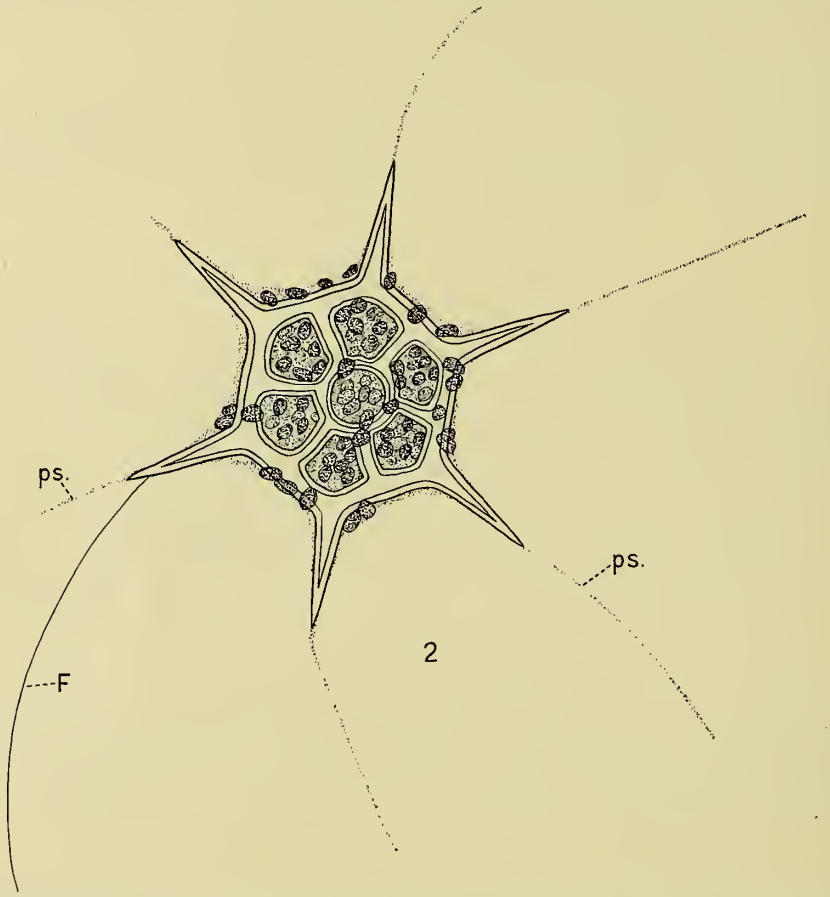
Text-fig. 1.—Diagrams showing the skeletons of *Dictyocha fibula* (left) and *Distephanus speculum* (right), viewed from the apical side. A.R. Apical ring. B.R. Basal ring. C.A. Central arch. R.S. Radial spine. S.B. Supporting bar. SS_a. Small spines directed apically. SS_b. Small spines directed abapically.

Substanz gefüllt, die das Netz auch auswendig überzog und verhüllte und war der Körper niemals in weiche Strahlen verlängert." This observation of his on the enveloping layer of protoplasm was unconfirmed, and indeed denied by subsequent workers until recently, but it is perfectly correct. Gemeinhardt describes and figures this "exoplasma" in *Distephanus speculum*, and it is even more clearly seen in *Dictyocha fibula*.

The cell body of a *Distephanus speculum* is of clear hyaline protoplasm. As a rule it extends beyond the skeleton, forming a delicate covering over it and reaching to the tips of the spines. There it is drawn out into exceedingly fine threads or pseudopodia (Text-fig. 2). These are mobile, and are very variable, being sometimes visible on every spine, sometimes only on one or two.* In an unhealthy specimen, or in one which has been long under the coverslip, they are not to be seen at all. Occasionally two threads are visible from the tip of one spine. When in motion they swing slowly backwards and forwards, and can

* I have found similar delicate pseudopodia extending beyond the tips of the spines in living Radiolaria (Acantharia).

probably alter their form also by amœboid movement. They vary greatly in length, and may be as long as 50μ. These pseudopodia resemble the flagellum very much in appearance, except that they are usually finer and do not move in the same way. The flagellum, as a rule, comes out close to the base of a spine, and extends beyond it for a short distance. Sometimes only the tip is in active motion, sometimes the whole flagellum is thrown into waves. In a healthy living specimen the small yellowish-brown chromatophores are embedded in the protoplasm, not only within the space enclosed by the skeleton, but also outside it. They tend to collect round the bases of the spines, and give the animal a typical

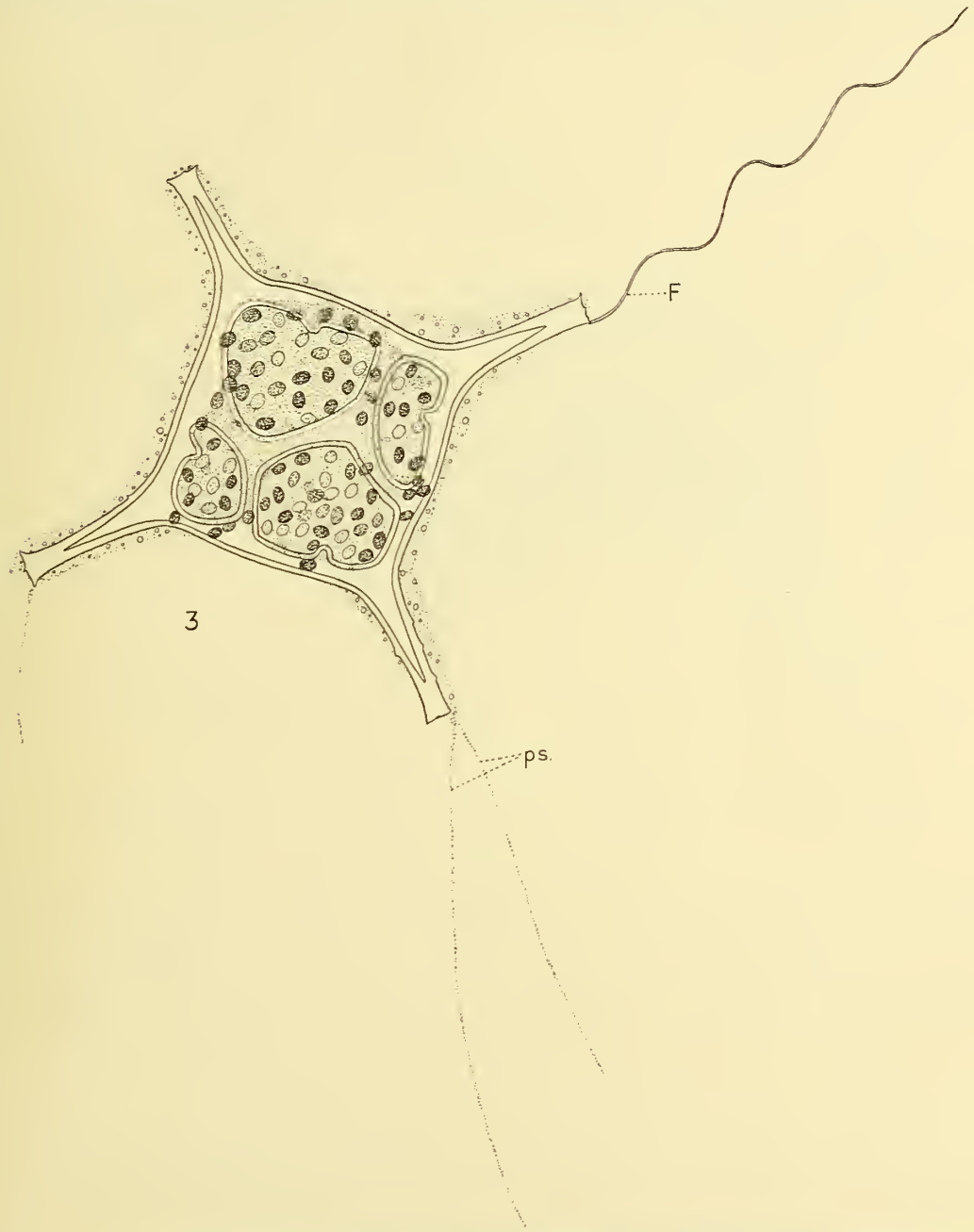


Text-fig. 2.—Living specimen of *Distephanus speculum*, showing pseudopodia (*ps.*) and flagellum (F.). From the Firth of Clyde.

rosette-like appearance. In many specimens, particularly those which have been long under observation, the chromatophores are contracted into a central mass within the skeleton. The flagellum may be visible even after this has taken place. The nucleus, which is not visible in the living cell, has been described by Gemeinhardt as spherical, containing one, or occasionally two, nucleoli. Borgert describes the nucleus as oval. He states that there is an intensely staining, round, chromatin body surrounded by a lightly staining layer, which is separated by a thin membrane from the cytoplasm. My observations agree with Borgert's, except that the nucleus is usually rounded, but may be rather irregular in shape.

In *Dictyocha fibula* (Text-fig. 3) the protoplasmic body is very similar to that of *Distephanus*. It shows the same enveloping layer, which in this case is much more obvious

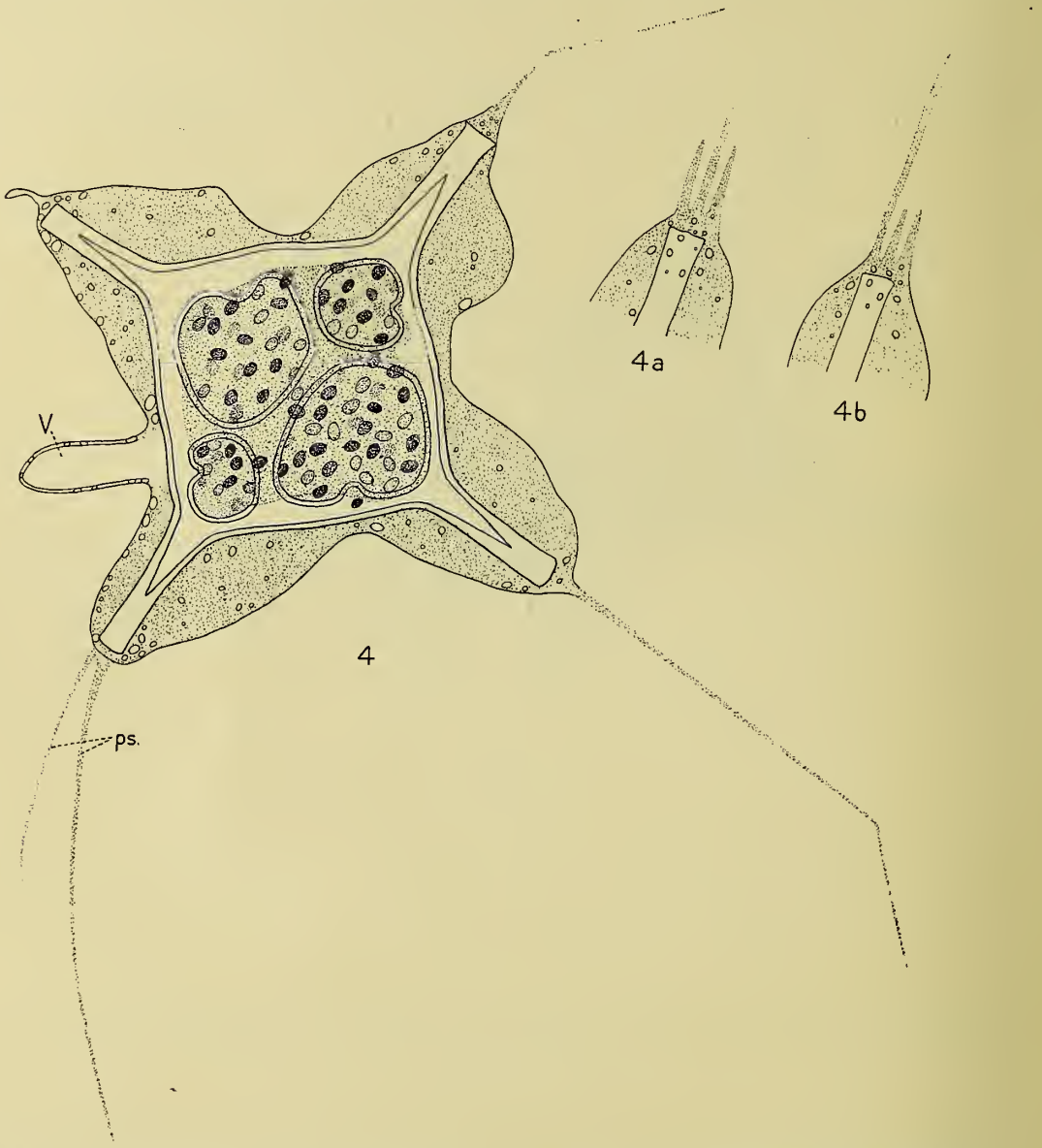
because it is filled with minute refractive granules, and is often more extensive. The fine pseudopodia are also seen, and these, besides showing backward and forward movements, may change their shape rapidly by amoeboid movements. A flagellum is not often seen



Text-fig. 3.—Living specimen of *Dictyocha fibula* viewed from the abapical side showing pseudopodia (*ps.*) and flagellum (F.). From the Firth of Clyde.

but, when present, is similar to that found in *Distephanus*. Chromatophores similar to those in *Distephanus* are present and show the same arrangement. In one specimen observed (Text-fig. 4) the cytoplasm outside the skeleton was much more extensive than usual and showed a definite external layer, which is not commonly seen. It formed broad lobes round the spines, from the tips of which extended very mobile pseudopodia (see

Text-figs. 4, 4*a*, 4*b*, which represent the same spine at short intervals of time). From about the middle of one side projected a long oval vacuole with a thin wall, and this remained constant in form and position for a considerable time, and even after fixation. The chromatophores were mostly massed in the centre, but the condition of the pseudopodia

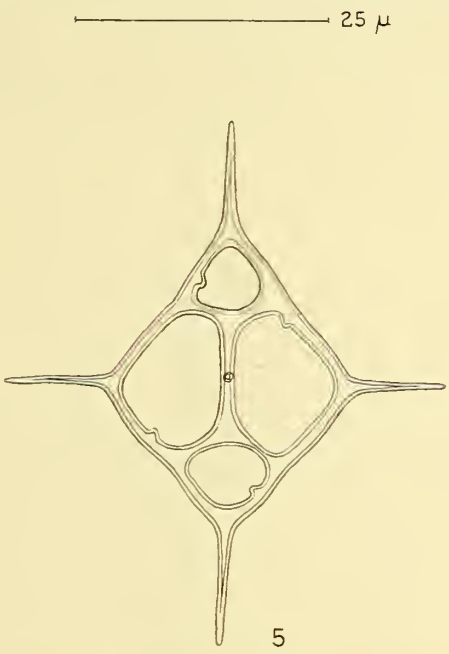


Text-fig. 4.—Living specimen of *Dictyocha fibula* viewed from the abapical side, showing a large amount of protoplasm and a vacuole (*v.*). 4*a* and 4*b* show further alterations in the pseudopodia effected by amoeboid movement. From the Firth of Clyde.

shows that this was a healthy specimen. Gemeinhardt states that before division the amount of protoplasm in *Distephanus* is increased, and it seems possible that this *Dictyocha* was about to divide, and that the vacuole indicated where a future spine would be laid down. If this were so, the resulting skeleton would be abnormal; but dividing forms are frequently seen, in which one member of the pair is normal and the other abnormal. The nucleus in *Dictyocha* is similar to that in *Distephanus*. It is more frequently irregular

in shape, however, and there are often small masses of darkly staining material along the membrane separating it from the cytoplasm. A more deeply staining nucleolus can sometimes be made out in the central mass.

I am indebted to Miss Brown Kelly for the drawings of Silicoflagellates.



Text-fig. 5.—*Dictyocha fibula* var. *stapedia*. From the Great Barrier Reef region.

Descriptions of Species.

Dictyocha fibula var. *stapedia* (Haeckel), Lemmermann. Text-fig. 5.

Gemeinhardt, 1930, p. 53, fig. 42.

Occurrence.—Found occasionally throughout the year, but only in small numbers. The highest numbers were obtained on 26th January near Low Isles (3 in 100 c.c.). Within the Great Barrier Reef they were distributed more or less evenly from the surface down to 28 metres (the greatest depth sampled), and at stations outside it the few specimens present were not taken below 20 metres.

Distribution.—The Atlantic, Indian and Pacific Oceans.

Remarks.—In this variety the basal ring is a rhomboid, and one pair of spines is slightly longer then the other. The central arch lies parallel to the longer axis.

Dimensions.—Total length as measured from spine tip to spine tip on the longer axis 39–52μ ; length of side 18–24μ ; length of spines 8–11μ and 7–9μ.

Dictyocha fibula var. *hexagona*, n. var. Text-fig. 6.

Gemeinhardt, 1931, p. 233, pl. xlii, fig. 15.

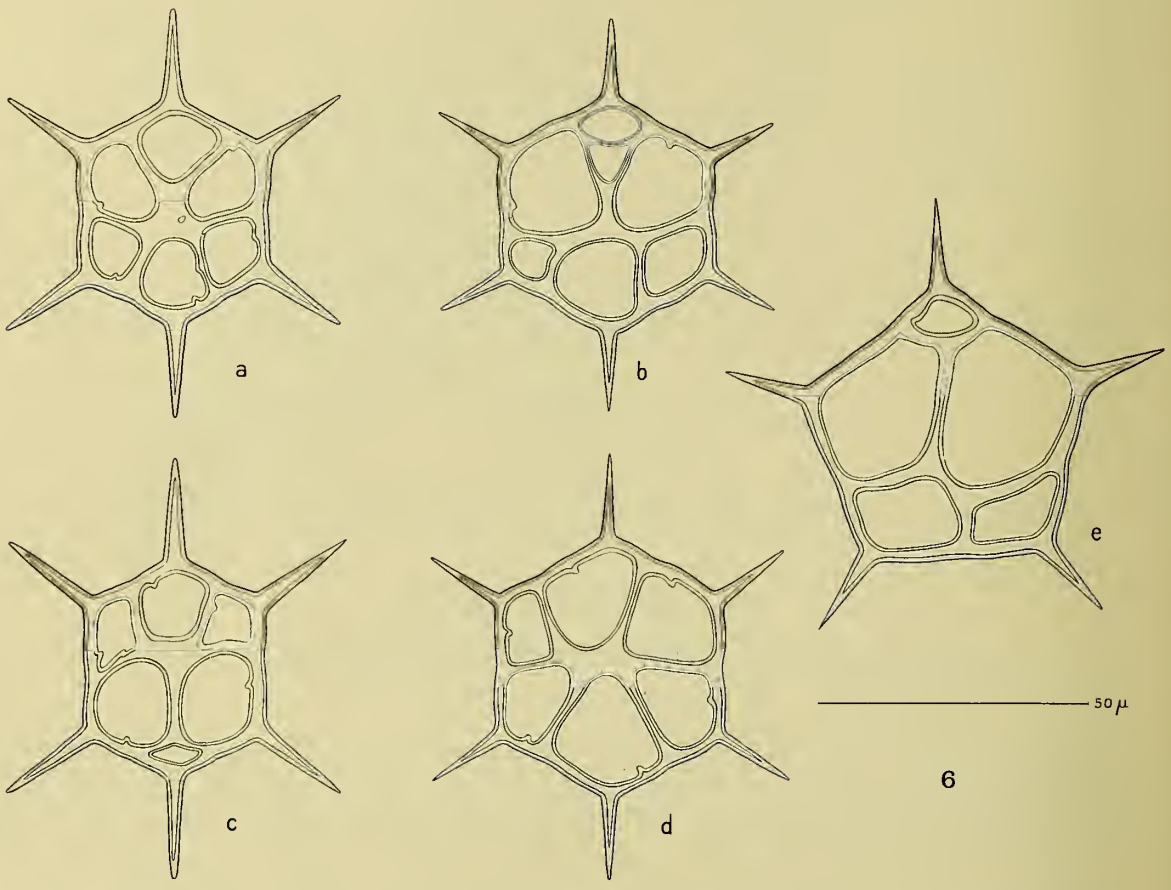
Occurrence.—Appeared only rarely throughout the year.

Distribution.—The Great Barrier Reef region.

Description.—This variety possesses no apical ring, and appears to be in some respects transitional between *Dictyocha* and *Distephanus*. It has a six-sided basal ring.

The supporting bars from adjacent sides fuse and the three resulting bars unite to form a roughly triangular area. Text-fig. 6*a* shows the usual form but there is a good deal of variation, and Text-figs. 6*b–e* show several specimens. Small spines are present on the basal ring in the usual position, and are not infrequent on the supporting bars. The five-sided form (Text-fig. 6*e*) was seen only twice.

Remarks.—This is a difficult form to place. Since it possesses no apical ring it must belong to the genus *Dictyocha*, but it has obvious affinities to *Distephanus speculum* forma *pseudo-fibula*, Schulz. Gemeinhardt (1931) found a single specimen in the material of the



Text-fig. 6.—*Dictyocha fibula* var. *hexagona*, n. var., showing variations in the skeleton. From the Great Barrier Reef region.

German South Polar Expedition, and figured it as an abnormal *Distephanus speculum*, suggesting, however, that it might be a transitional form between *Mesocena polymorpha* var. *hexagona* and *Dictyocha*. Since it appears with fair regularity in the Great Barrier Reef material, it may be classed as an independent variety. A six-sided *Dictyocha*, *D. hexacantha*, Schulz, is already known (as a fossil only), but differs from this in having only three supporting bars, rising opposite the bases of alternate radial spines.

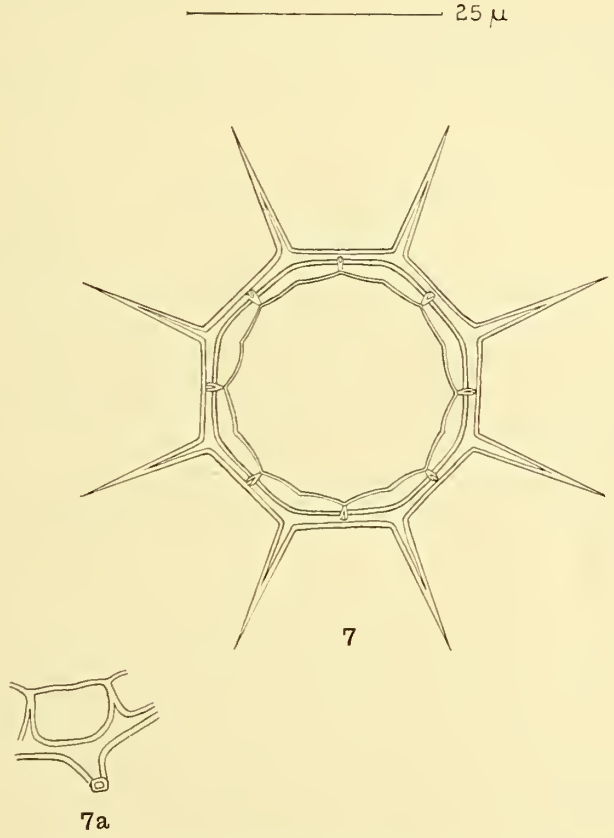
The five-sided form (Text-fig. 6*e*) corresponds to *Dictyocha fibula* var. *pentagona*.

Dimensions.—Diameter of basal ring 39–47μ ; diameter from spine-tip to spine-tip, 72–86μ ; length of one side 24–26μ ; length of radial spines 13–17μ.

Distephanus speculum var. *bioctonarius* (Ehrenberg). Text-fig. 7.

Mesocena polymorpha var. *bioctonaria*, Gemeinhardt, 1930, p. 32, fig. 17.
Distephanus speculum var. *octonarius*, Gemeinhardt, 1930, p. 69, figs. 59*b*, 60.

Occurrence.—Appeared occasionally throughout the year in small numbers. In water samples they were never more abundant than one in 100 c.c. The station at which most were obtained was H 28 on 19th November, outside Trinity Opening, where they were not taken deeper than 50 m.



Text-fig. 7.—*Distephanus speculum* var. *bioctonarius*. 7*a*. Detail of skeleton. From the Great Barrier Reef region.

Distribution.—The North Sea, the Atlantic, Pacific and Antarctic Oceans; widely distributed as a fossil.

Remarks.—The distinguishing feature of this variety, apart from its octagonal form, is the extreme delicacy of the apical ring. This has a diameter almost as great as that of the basal ring, and is solid, not hollow like the rest of the skeleton. The cavity extends only about half-way up the supporting bars (Text-fig. 7*a*). The apical ring does not always form a double arch between each pair of bars as is shown in Text-fig. 7. The radial spines are square in cross-section (Text-fig. 7*a*). Small spines were occasionally present on the apical ring, but none were observed on the basal ring. One specimen was seen with nine-sided basal and apical rings.

This variety was first found as a fossil (Ehrenberg, 1845, p. 78), and, since it lacked the apical ring either partly or wholly, was described as *Mesocena bioctonaria*. The form

possessing both basal and apical rings was put by Gemeinhardt in *Distephanus speculum* var. *octonarius* (Ehrenberg), Jörgensen. This variety *octonarius* does not, however, differ at all from the typical form except in having eight sides, and it seems to me better to keep Ehrenberg's name for the forms with a solid, delicate, apical ring. The number of sides is an exceedingly variable character throughout the family, and individual abnormalities seem to be frequent; forms with a solid apical ring, on the other hand, have not been described except in *Distephanus speculum*. They may occur with seven (Gemeinhardt, 1930), eight or nine sides. The variety is well marked and occurs regularly in the plankton (Gemeinhardt, 1931, Schulz, 1928, and present records).

Dimensions.—Diameter of basal ring 28–30μ; diameter of apical ring about 23μ; length of radial spines varying from one specimen to another, 4–13μ.

THE TINTINNOINEA.

Introduction.

The Tintinnids described below are those captured in tow-nettings taken with the International fine silk net described by Russell and Colman (1931, Vol. II, No. 2). The majority of the catches were taken at the weekly station, but two were from stations in the main channel further to the north (Cape Bedford and Lizard Island), and three in passages through the outer barrier (Trinity Opening and Papuan Pass). For the positions of these stations reference should be made to the charts in Vol. II, No. 1 (Russell and Orr, 1931). Work was carried on from July, 1928, till July, 1929, and the results therefore apply to a complete year.

Kofoid and Campbell have recently published (1929) a conspectus of the order Tintinnoinea, in which they review the entire group and the literature concerning it. I am greatly indebted to this work and have throughout followed their classification, which is based entirely on the lorica. Recent work by Hofker (1931) indicates that a study of the lorica alone is not sufficient for a final classification, since there is much variation in shape and structure, and that a number of Kofoid and Campbell's species are in reality only variant forms. At present, however, the lorica is in many cases the only part of the animal available for identification, and descriptions must be based on it.

Fifty-six species occur, of which three are new.

I am greatly indebted to Miss Brown Kelly for the drawings which illustrate this report, with the exception of Text-figs. 8–11.

List of Species.

Tintinnididae.

**Leprotintinnus nordqvisti* (Brandt).

Codonellidae.

Tintinnopsis compressa, Daday.
**T. mortensenii*, Schmidt.
†*T. rotundata*, Jörgensen.
‡*T. gracilis*, Kofoid and Campbell.
T. radix (Imhof).
T. cylindrica, Daday.
†*T. tocantinensis*, Kofoid and Campbell.

Codonellopsidae.

Stenosemella nivalis (Meunier), Kofoid and Campbell.
**Codonellopsis ostenfeldii* (Schmidt).
**C. indica*, Kofoid and Campbell.
§*C. parvicollis*, n. sp.
‡*C. brevicaudata*, Brandt.

Coxliellidae.

Climacocylis scalaria (Brandt), Jörgensen.
‖*C. scalaroides*, Kofoid and Campbell.
**Coxliella laciniosa* (Brandt).

CYTTAROCYLIDAE.
**Favella azorica* (Cleve), Jörgensen.

PTYCHOCYLIDAE.
‡*Epiplocylis ralumensis* (Brandt).
‖*E. healdi*, Kofoid and Campbell.
‡*E. constricta*, Kofoid and Campbell.
‖*E. exigua*, Kofoid and Campbell.
E. blanda (Jörgensen), Kofoid and Campbell.
E. undella (Ostenfeld and Schmidt).
‡*E. deflexa*, Kofoid and Campbell.

PETALOTRICHIDAE.
§*Craterella aperta*, n. sp.
‖*Metacylis corbula*, Kofoid and Campbell.

RHABDONELLIDAE.
Protorhabdonella simplex (Cleve), Jörgensen.
P. curta (Cleve), Jörgensen.
Rhabdonella spiralis (Fol). Brandt.
R. brandti, Kofoid and Campbell.
‖*R. quantula*, Kofoid and Campbell.
R. amor (Cleve), Brandt.
‖*Rhabdonellopsis intermedia*, Kofoid and Campbell.

XYSTONELLIDAE.
Xystonella lanceolata (Brandt), Brandt.
X. treforti (Daday), Laackmann.

UNDELLIDAE.
**Undella hemispherica*, Laackmann.
‖*U. turgida*, Kofoid and Campbell.
**Proplectella tenuis*, Kofoid and Campbell.
‖*P. perpusilla*, Kofoid and Campbell.
†*P. acuta* (Jörgensen).

DICTYOCYSTIDAE.
Dictyocysta reticulata, Kofoid and Campbell.

TINTINNIDAE.
Amphorella quadrilineata (Claparède and Lachmann), Daday.
A. brandti, Jörgensen.
†*A. laackmanni* Jörgensen.
†*A. minor*, Jörgensen.
Steenstrupiella steenstrupii (Claparède and Lachmann).
†*S. intumescens*, Jörgensen.
**Amphorellopsis acuta* (Schmidt).
Dadayiella ganymedes (Entz Sr.), Kofoid and Campbell.
Tintinnus attenuatus, Kofoid and Campbell.
T. lusus-undae, Entz Sr.
‖*T. stramentus*, Kofoid and Campbell.
‖*T. pacificus*, Kofoid and Campbell.
T. apertus, Kofoid and Campbell.
§*Daturella luanae*, n. sp.
‖*Salpingella subconica*, Kofoid and Campbell.

DISTRIBUTION.

Among the Tintinnids obtained by the Expedition two groups can be distinguished: firstly, those adapted to neritic conditions, and secondly, those which are oceanic in habitat and are restricted to water of relatively high salinity. Members of the first group are found throughout the year and are often especially common in March. They include most species of the genera *Leprotintinnus*, *Tintinnopsis* and *Codonellopsis*, and *Epiplocylis healdi*, *Rhabdonella spiralis*, *R. brandti* and *R. amor*. Members of the second group are rarer, and occur mainly at the weekly station in August and September (when the salinity inside the Barrier was over 35°/$_{oo}$), and at stations on or near the outer reefs. Such species are *Climacocylis scalaria*, *Epiplocylis* spp. (apart from *E. healdi*), *Rhabdonella quantula*, *Rhabdonellopsis intermedia*, *Xystonella* spp., *Undella* spp., and *Daturella luanae*. The remainder are either too rare to give an accurate indication of their habitat, or do not conform strictly to either group, although a number were more common at outside stations (*e.g. Proplectella* spp. and *Climacocylis scalaroides*).

Of the fifty-six species listed, twenty-two (unmarked in the above list) are cosmopolitan and have been recorded from the Atlantic, Pacific and Indian Oceans, sometimes from temperate and even arctic regions. Nine species (marked with *), are restricted to warm seas, although they may be widely distributed within the tropics. Of the numerous new species found by Kofoid and Campbell from the Agassiz Expedition to the eastern tropical Pacific, eleven (marked with ‖) can now be recorded from the western Pacific also. Five (marked with ‡) have hitherto been recorded by Brandt from the western Pacific (of which two have also been found by Kofoid and Campbell in the eastern Pacific).

The records of six species (marked with †) are so scattered that their distribution cannot be ascertained at all accurately. The remaining three species (marked with §) are new.

Table I shows the occurrence of the species throughout the year at the stations examined, and for this records from water samples have been used, where available, as well as those from tow-nettings. It will be seen that catches from outside stations are usually rich in species, although they lack the neritic forms. One of the richest catches (for numbers of species) was that from Lizard Island on 27th February. This is partly because, being near the outer reefs, oceanic as well as neritic species are represented, and partly because diatoms were abundant. These tend to block the meshes of the net, so that small species which would otherwise be lost are retained. The richest catch of all (containing forty-three species) was obtained, however, at the weekly station on 4th March. Twenty-one out of the fifty-six species are present throughout the year, and may be considered as characteristic of the fauna of the Great Barrier Reef lagoon.

The results from stations on or near the outer reefs suggest that there is a rich tintinnid fauna in the ocean waters outside, of which only some species can live permanently within the Barrier.

In the following descriptions reference is made only to the earliest description of the species and to Kofoid and Campbell's monograph, where a full list of synonyms will be found.

Descriptions of Species.

Leprotintinnus nordqvisti (Brandt).

Tintinnopsis nordqvisti, Brandt, 1906, pp. 4, 18 ; pl. xxiv, figs. 1–4 ; 1907, pp. 166–167.
Leprotintinnus nordqvisti, Kofoid and Campbell, 1929, p. 17, fig. 13.

Occurrence.—This species was present throughout the year and was abundant in November and March. It was not taken outside the Great Barrier Reef.

Distribution.—The N. coast of South America and the mouth of the Amazon; Siam, Malay Archipelago, and west coast of Borneo.

Remarks.—The lorica decreases slightly in width towards the aboral end and then flares out to the aboral opening, which is wider (58–123μ) than in the specimens described hitherto (mouth of the Amazon 50–60μ ; coast of Borneo 40–52μ). There is sometimes an indication of a spiral structure in the arrangement of agglomerated material on the tube, but this is never clear.

Dimensions.—Length 125–254μ ; diameter at mouth 34–44μ ; diameter at aboral end 58–123μ ; diameter just above aboral flare 30–34μ.

Tintinnopsis compressa, Daday. Text-fig. 8.

Tintinnopsis beroidea var. *compressa*, Daday, 1887, p. 548, pl. xix, figs. 7–9, 28. *T. nucula*, Daday, *ibid.*, p. 554, pl. xix, figs. 30, 31.
Tintinnopsis compressa, Kofoid and Campbell, 1929, p. 32, fig. 71.

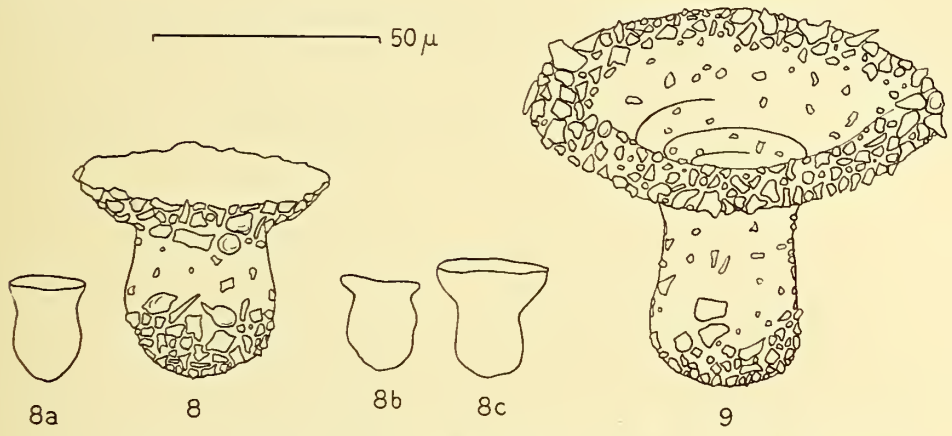
Occurrence.—Occasional throughout the year and common in March.

Distribution.—The Mediterranean ; the Red Sea ; Woods Hole, Massachusetts.

Remarks.—Kofoid and Campbell have united Daday's *T. beroidea* var. *compressa* and his *T. nucula* to form this species, which has also been described from the Mediterranean by Jörgensen (1924).

The present specimens are variable in form. Some of them agree well with the figures of Daday and Jörgensen, but the majority have a more marked suboral constriction and a more spreading brim. Text-fig. 8 shows what is perhaps the most common form. Text-figs. 8*a*, 8*b*, 8*c* are sketches (on a smaller scale) of other varieties, of which 8*a* resembles Daday's form most closely.

Dimensions.—Length 39–59μ ; diameter at mouth 34–65μ ; greatest diameter of bowl 28–34μ.



Text-figs. 8, 9.—8, 8*a*, 8*b*, 8*c*. *Tintinnopsis compressa*. 9. *T. mortensenii*.

Tintinnopsis mortensenii, Schmidt. Text-fig. 9.

Tintinnopsis mortensenii, Schmidt, 1902, p. 186, fig. 3 ; Kofoid and Campbell, 1929, p. 40, fig. 61.

Occurrence.—Common in November and March, otherwise occasional.

Distribution.—The Gulf of Siam ; the mouth of the Tocantins.

Remarks.—The marked feature of this species is the wide spreading brim. In the specimens from Siam (Schmidt) the diameter of the brim was 53μ, in those from the mouth of the Tocantins (Brandt, 1907, p. 152) 85μ, and in those from the Great Barrier Reef material it varies from 67 to 108μ. In length the Great Barrier Reef specimens are intermediate between those of Brandt and Schmidt. The species also resembles *T. bütschli* Daday, but is considerably smaller, and has a wider brim in proportion to the length. The agglomerated material is thinly scattered on the proximal part of the brim, but is very thick at the edge. A spiral structure can usually be made out in the throat.

Dimensions.—Total length 60–70μ ; greatest width of bowl 29–38μ ; width of brim 67–108μ.

Tintinnopsis rotundata, Jörgensen.

Tintinnopsis beroidea, Daday, 1887, p. 547, pl. xix, figs. 2, 14.
Tintinnopsis rotundata, Kofoid and Campbell, 1929, p. 46, fig. 73.

Occurrence.—Present during most of the year and common in March.

Distribution.—At Wismer in the Baltic ; the Gulf of Naples.

Remarks.—This is a very regular form and varies little in dimensions. It also resembles closely *T. tenuis* Hada, 1932, from which it differs only in the lack of spiral marking.

Dimensions.—Length 52–57μ ; width 26–28μ.

Tintinnopsis gracilis, Kofoid and Campbell.

Tintinnopsis karajacensis var. a, Brandt, 1906, p. 16, pl. xix, figs. 1, 2, 21 ; 1907, p. 163.
Tintinnopsis gracilis, Kofoid and Campbell, 1929, p. 36, fig. 37.

Occurrence.—Present throughout the year and was abundant in November and March.

Distribution.—The west coast of Borneo.

Remarks.—This form agrees exactly with that figured by Brandt (1906, pl. xix, fig. 2). It is almost cylindrical, widening slightly from the mouth to the lower third and then narrowing to a bluntly conical point.

Dimensions.—Length 123–177μ ; diameter at mouth 34–38μ ; greatest diameter 38–44μ.

Tintinnopsis radix (Imhof). Text-fig. 10.

Codonella radix, Imhof, 1886, p. 103.
Tintinnopsis radix, Kofoid and Campbell, 1929, p. 45, fig. 93.

Occurrence.—Present throughout the year at the weekly station and sometimes abundant (November, March).

Distribution.—A neritic species with a wide distribution along the coasts of the Mediterranean and the Atlantic, Indian and Pacific Oceans.

Remarks.—This species is certainly the *T. fracta* of Brandt (1906, p. 4, pl. xxiii, figs. 1, 3–5, 9–13 ; pl. xxxi, fig. 8 ; 1907, pp. 174–176). He separated it from similar forms (notably *T. curvicauda*, Daday) on account of the opening at the posterior end, which is now generally considered to be an artefact, possibly caused by fixation (Jörgensen, 1924). The opening is always in the same position, on one side of the pedicel ; it extends to the foot and often has a very regular edge ; moreover Brandt says that it was present in every tropical specimen he examined, and this is also true of the Great Barrier Reef material. It is possible that the animal is attached at this point, and that it tears a hole there in leaving its case, or at death by fixation. Further observations on living material are needed to clear up this point, and until this is done it is perhaps better to unite forms which are alike (as Kofoid and Campbell have done), whether they are open at the tip or not. The present material was fixed in formalin, so the break is not caused, as Jörgensen suggests, by alcohol fixation only.

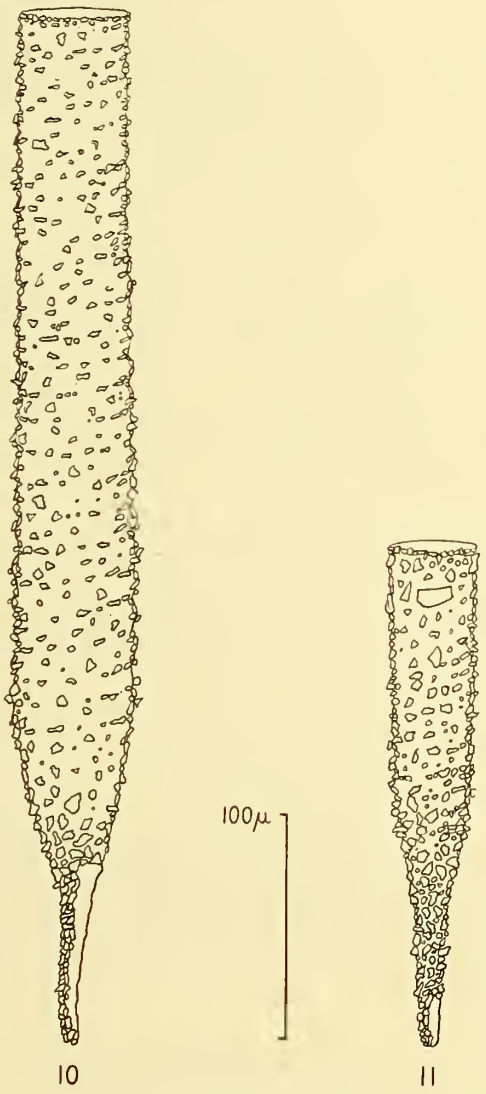
The length, if we consider those from other localities also, is very variable, and in this case (unlike the Tintinnidae) the oral diameter is variable as well. The sizes of the present specimens agree most closely with those of Brandt from the west coast of Borneo (1907, p. 175). The lorica is almost cylindrical for about two-thirds of its length ; it often gets slightly wider towards the bowl, and rarely slightly narrower. In the basal third it narrows to a slender and slightly curved pedicel. A spiral structure is clearly visible from the mouth down to the narrowing. The pedicel and the part close to the mouth are thickly covered with agglomerated particles, but on the rest of the lorica they are scarcer.

Dimensions.—Length 353–502μ ; diameter at mouth 46–61μ ; length of pedicel (measured from where lorica begins to narrow) 116–172μ ; 24–30 spiral turns on the cylindrical part of bowl.

Tintinnopsis cylindrica, Daday. Text-fig. 11.

Tintinnopsis Davidoffii var. *cylindrica*, Daday, 1887, partim, p. 553, pl. xix, fig. 24.
Tintinnopsis cylindrica, Kofoid and Campbell, 1929, p. 33, fig. 96.

Occurrence.—Present throughout the year at the weekly station and sometimes abundant (November and March).



Text-figs. 10, 11.—10. *Tintinnopsis radix*. 11. *T. cylindrica*.

Distribution.—The Mediterranean, the Baltic, the western Pacific.

Remarks.—In two respects this form differs from the type. It often shows a rather indistinct spiral marking, and the tip of the pedicel is open. In this and other respects it resembles *T. radix*. It is smaller than the Great Barrier Reef *T. radix* (although a few specimens of intermediate size are found), but is about the same size as *T. radix* from other localities (*e. g.* Brandt's *T. fracta* from New Pomerania, Zanzibar and S.W. Africa). The pedicel is wider and usually nearly half as long as the whole lorica ; it is very frequently broken off short ; the diameter is less and the lorica invariably gets slightly narrower

towards the pedicel; it is more thickly encrusted with agglomerated material; a spiral structure is often visible, especially towards the pedicel, but it is much less distinct than in *T. radix*. Hada's *T. kofoidi* (1932*a*) resembles this form, but lacks the spiral marking and has straighter sides.

Dimensions.—Length 144–300μ; diameter at mouth 34–45μ (one specimen 50μ); length of pedicel 62–120μ; 8–13 spiral turns on bowl.

Tintinnopsis tocantinensis, Kofoid and Campbell.

Tintinnopsis aperta var. a, Brandt, 1906, p. 19, pl. xxv, figs. 2, 7; 1907, p. 177.
Tintinnopsis tocantinensis, Kofoid and Campbell, 1929, p. 48, fig. 46.

Occurrence.—Very rare. It appeared at a few of the weekly stations in March and April, and off Lizard Island in February.

Distribution.—Off the mouth of the Tocantins River, and in Mutsu Bay, Japan.

Remarks.—This form agrees very closely with Brandt's figure and, like his, is open at the aboral end. In one specimen there was a faint suggestion of spiral marking just below the mouth.

Dimensions.—Length 65–92μ; diameter at mouth 17–19μ; greatest diameter of bowl 22–28μ.

Stenosemella nivalis (Meunier), Kofoid and Campbell.

Codonella ventricosa, Entz Sr., 1884, p. 413, pl. xxiv, fig. 24.
Stenosemella nivalis, Kofoid and Campbell, 1929, p. 69, fig. 136.

Occurrence.—Very rare. In February off Lizard Island, and in October and March at the weekly station.

Distribution.—The Mediterranean and the coast of Europe generally; Mutsu Bay, in Japan.

Remarks.—This is a very small form and seems to vary considerably in shape. The collar contracts a little towards the mouth and is often scarcely emergent. The lorica is usually widest shortly below the collar, and has a broadly rounded aboral end. A good figure is given by Hada, 1932, Text-fig. 11.

Dimensions.—Total length 31–34μ; diameter at mouth 16–19μ; greatest diameter 30μ; height of collar up to 6μ.

Codonellopsis ostenfeldii (Schmidt).

Codonella ostenfeldii, Schmidt, 1902, p. 187, fig. 4.
Codonellopsis ostenfeldi, Kofoid and Campbell, 1929, p. 84, fig. 160.

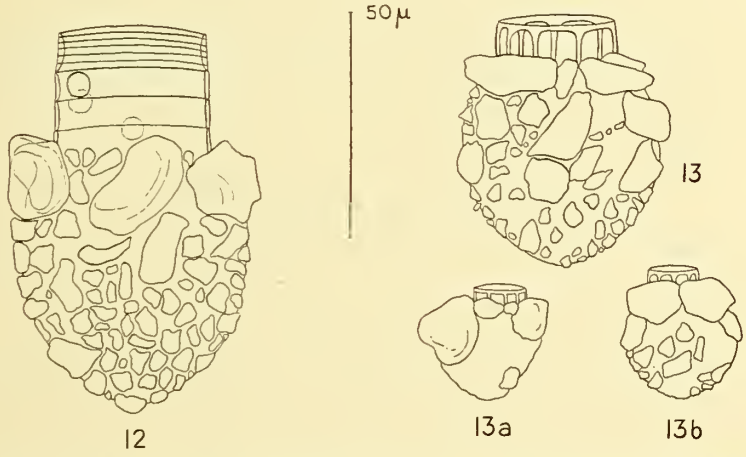
Occurrence.—Common all year, abundant in August, November and March. One of the commonest tintinnids in these waters.

Distribution.—The Red Sea and Arabian Sea; the Indian Ocean; the Malay Archipelago; off Zanzibar; the Gulf of Siam; off the coast of Borneo.

Remarks.—This species is distinguished by a long collar, built up of a fenestrated spiral lamina whose edge can be seen as a line between the rows of fenestrae. The bowl is ovate often with projecting shoulders where the collar and bowl join, and is covered with agglomerated particles, often large. The collar is slightly everted at the oral end, and

sometimes, especially when it is long, narrows slightly where it meets the bowl. The number of turns in the spiral lamina varies greatly, every number from 3 to 15 being counted from a single tow-netting (Station 51). Brandt records the number of turns as 3–6, usually 4 or 5, but sometimes 9–12. Schmidt has recorded specimens from the Gulf of Siam with as many as 18. The top and, less frequently, the bottom turn of the spiral of fenestrae is sometimes incomplete or has fenestrae markedly smaller than the rest. The lamina usually makes several free turns (*i. e.* without fenestrae) just below the mouth. There may be several free turns at the foot of the collar also. Brandt (1907) has pointed out that the fenestrae are not really holes, but that the wall is much thinner there. He has given a good figure of the species (1906, pl. xiv, fig. 2).

Dimensions.—The total length depends almost entirely on the length of the collar, 99μ (3 turns)–189μ (13–15 turns); diameter at mouth 38–42μ. Bowl a little longer than wide, 59–77μ long by 60–65μ wide.



Text-figs. 12, 13.—12. *Codonellopsis indica*. 13, 13*a*, 13*b*. *C. parvicollis*.

Codonellopsis indica, Kofoid and Campbell. Text-fig. 12.

Codonella morchella partim, Brandt, 1906, p. 15, pl. xiii, fig. 3; pl. xiv, fig. 3; 1907, p. 124.
Codonellopsis indica, Kofoid and Campbell, 1929, p. 80, fig. 158.

Occurrence.—Present throughout the year, but was never as common as *C. ostenfeldii*.

Distribution.—Off Zanzibar; off Borneo.

Remarks.—This species differs from the last in the much smaller number and irregular arrangement of fenestrae on the collar. The agglomerated particles are often very large, especially on the shoulders, as is shown in Brandt's second figure (pl. xiv, fig. 3). This species seems to differ very little from *C. americana*, Kofoid and Campbell, and *C. orientalis*, Hada (1932), the distinguishing characters being only slight differences in the shape of the bowl, which, in the Great Barrier Reef material, is rather variable.

C. americana is described as having a more rotund bowl, and *C. orientalis* a more pointed aboral end.

Dimensions.—Total length 73–94μ; length of collar 21–39μ; diameter at mouth 30–36μ; dimensions of bowl 47–60μ long by 44–54μ wide; 6–12 spiral turns on the collar with 1–3 scattered fenestrae.

Codonellopsis parvicollis, n. sp. Text-fig. 13.

Occurrence.—Appeared throughout the year.

Distribution.—The Great Barrier Reef region.

Description.—The total length is a little more than twice the oral diameter. The bowl is ovate, a little longer than wide, and is thickly covered with agglomerated particles, frequently of large size and irregular shape. These agglomerations are often particularly large on the shoulders just below the collar, as is shown in Text-figs. 13*a* and 13*b*.

The collar is short and has only one row of fenestrae, usually 6 or 7 in number. They are irregular in shape, and are usually rectangular rather than circular or oval. In only one specimen one or two irregular fenestrae were seen below the usual single circle.

The species is a little reminiscent of Daday's (1886) *Dictyocysta ovalis*, but the shape of the collar is different, and the present species has never been seen with coccoliths. It differs from the other species of the genus in the short collar.

Dimensions.—Total length 48–61μ ; dimensions of bowl 43–56μ long by 39–51μ wide ; height of collar 5–9μ (13 in the specimen with a double row of fenestrae) ; diameter at mouth 22–29μ.

Codonellopsis brevicaudata (Brandt).

Codonella brevicaudata, Brandt, 1906, pp. 3, 14, pl. iv, fig. 19, pl. xi, fig. 7 ; pl. xii, figs. 2 and 2*a* ; 1907, p. 118.
Codonellopsis brevicaudata, Kofoid and Campbell, 1929, p. 77, fig. 178.

Occurrence.—Seen only in the catch from off Lizard Island, in February.

Distribution.—Pacific Ocean, near New Pomerania.

Remarks.—The single specimen seen agreed in all respects with those described and figured by Brandt.

Dimensions.—Total length 178μ ; length of collar 101μ ; diameter at mouth 53μ ; dimensions of bowl 77μ long by 60μ wide ; 20 spiral turns on collar.

Climacocylis scalaria (Brandt), Jörgensen.

Cyttarocylis (*Coxliella*) *scalarius*, Brandt, 1906, pl. xxi, fig. 15 ; pl. xxvi, figs. 4–6 ; pl. xxvii, figs. 2, 3 ; 1907, pp. 264–267.
Climacocylis scalaria, Kofoid and Campbell, 1929, p. 93, fig. 185.

Occurrence.—In Papuan Pass in February.

Distribution.—Widely distributed in the Atlantic ; also obtained off Madagascar and in the Pacific.

Remarks.—The lorica of the genus *Climacocylis* is very inconspicuous and may easily be overlooked. It consists of a cylindrical tube, open at the aboral end, which is expanded into a large irregular mass or frill. A spiral band is visible on the cylindrical part, and this band bears a projecting ridge or shelf. The shelf becomes wider towards the aboral end. The secondary structure is well marked and consists of large irregularly hexagonal meshes, but the lorica as a whole is extraordinarily delicate and transparent.

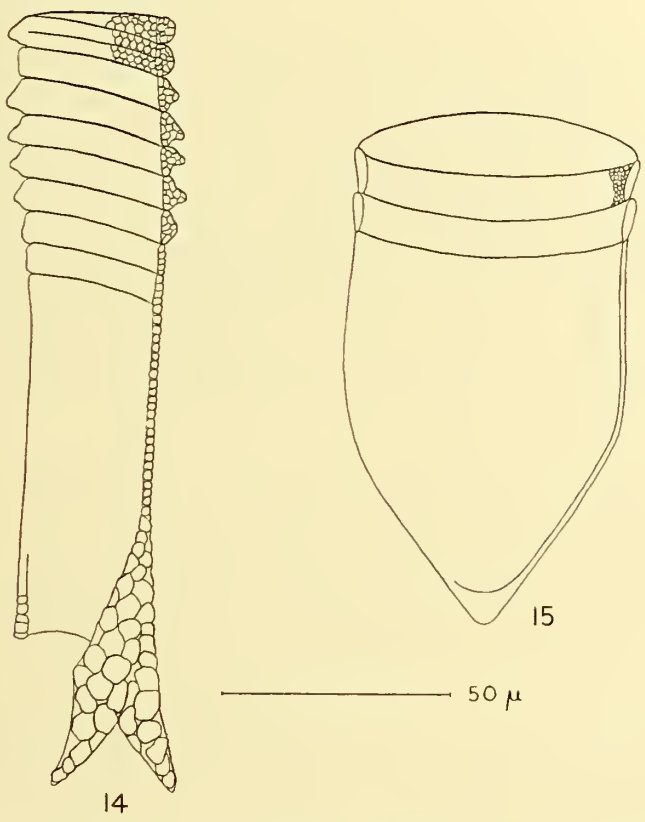
Dimensions.—Length, excluding frill, 181–258μ ; length of frill 65–86μ ; diameter at mouth 47–52μ ; number of spiral turns 4–13.

Climacocylis scalaroides, Kofoid and Campbell. Text-fig. 14.

Cyttarocylis scalarius var. a, Brandt, 1907, pp. 266–267.
Climacocylis scalaroides, Kofoid and Campbell, 1929, pp. 93, fig. 187.

Occurrence.—At Trinity Opening in August and November; in Papuan Pass in February; and at the weekly station occasionally during the year.

Distribution.—The Pacific, in the California Current, North Equatorial Current, Panamic area and South Equatorial Current; south-west of Australia; Bay of Biscay and Mediterranean; off Madagascar; the junction of the Labrador and Florida Currents.



Text-figs. 14, 15.—14. *Climacocylis scalaroides*. 15. *Favella azorica*.

Remarks.—The lorica of this species also is very delicate and transparent. It is narrower and usually smaller than the preceding species. The spiral band is restricted to the upper part and may show from five to ten turns. Of these the lowest one or two are usually flat, but the rest are produced into a rounded ridge. The lorica may be cylindrical or may narrow a little towards the aboral end, but this is partially closed by a great thickening in the wall. There are almost always one or, more frequently, two triangular prolongations from one side of the aboral end. The secondary structure is similar to that of the preceding species and the meshes become very large in the caudal prolongations. The species as described by Kofoid and Campbell does not have these caudal flaps, but they are not invariably present and the form otherwise agrees very well.

Dimensions.—Length 90–224μ ; diameter at mouth 30–37μ ; number of spiral turns 4–17. One specimen was found measuring 271μ in length and 56μ in oral diameter. It had no caudal prolongation. In structure (apart from the aboral end) it resembled *C. scalaroides*, but in dimensions was nearer to *C. scalaria*.

Coxliella laciniosa (Brandt).

Cyttarocylis ? (*Coxliella*) *ampla* (*?*) var. a, *laciniosa*, Brandt, 1906, p. 20, pl. xxviii, figs. 1, 2, 4 ; pl. xxix, fig. 3 ; *Cyttarocylis ?* (*Coxliella*) *laciniosa*, 1907, p. 270.
Coxliella laciniosa, Kofoid and Campbell, 1929, p. 100, fig. 193.

Occurrence.—Very rare. Found singly in Papuan Pass, and in March at the weekly station.

Distribution.—Widely distributed in the warm regions of the Atlantic ; the Mediterranean ; the Indian Ocean (off Madagascar) and the western Pacific (New Pomerania).

Remarks.—The two specimens observed are slightly wider towards the foot of the bowl than at the mouth, and end in a short blunt pedicel. The wall is thick at the mouth and thins out aborally but, unlike Brandt's specimens, is built up with only one layer of primary structure meshes. The primary meshes are small near the mouth, increase in size in the second and remain large in the third, fourth and fifth turn from the mouth. After this they decrease. There are numerous oval fenestrae between the sixth and seventh spiral turns.

Dimensions.—Length 93 and 95μ ; diameter at mouth 60 and 58μ ; greatest width 64μ ; wall about 3μ thick near mouth ; 8 spiral turns.

Favella azorica (Cleve), Jörgensen. Text-fig. 15.

Undella azorica, Cleve, 1900, p. 974, fig. (10).
Favella azorica, Kofoid and Campbell, 1929, p. 151, fig. 284.

Occurrence.—Rare. Appeared occasionally throughout the year.

Distribution.—The Azores ; the Mediterranean ; the Persian Gulf ; the Gulf of Siam ; the Fukien Strait.

Remarks.—The lorica is campanulate and is nearly twice as long as broad. It is almost cylindrical in the upper half to two-thirds and then tapers to a blunt, solid point. There are usually one or two annuli present at the oral end, but these may be absent. The two lamellae of the wall are not distinct, as in Jörgensen's specimens.

Kofoid and Campbell suggest that this may be a *Proplectella* sp., but the secondary structure is that typical of *Favella*, and there seems no reason to doubt Jörgensen's classification. Cleve's original figure shows no annuli, but these are not always present and the shape and size agree well. *F. composita* (Jörgensen) is similar in shape and the possession of annuli, but these are numerous and very narrow.

Dimensions.—Length 73–107μ ; diameter at mouth 47–65μ ; number of annuli none, 1 or 2.

Epiplocylis ralumensis (Brandt).

Ptychocylis reticulata var. *ralumensis*, Brandt, 1906, pp. 28, 29 ; pl. lviii, figs. 3, 8 ; 1907, p. 289.
Epiplocylis ralumensis, Kofoid and Campbell, 1929, p. 184, fig. 320.

Occurrence.—Very rare. One specimen from the station off Lizard Island, and one in March from the weekly station.

Distribution.—The western tropical Pacific.

Remarks.—The two specimens seen were a little shorter than Brandt's, but otherwise resembled his figure closely.

Dimensions.—Length 69–73μ ; diameter at mouth 47–49μ and (including collar) 57μ.

Epiplocylis healdi, Kofoid and Campbell. Text-fig. 16.

Epiplocylis healdi, Kofoid and Campbell, 1929, p. 180, fig. 321.

Occurrence.—Present throughout the year.

Distribution.—The Peruvian Current, Mexican Current, Panamic area, South Equatorial Drift and Galapagos Eddy.

Remarks.—This is the most abundant species of the genus in the Great Barrier Reef material. It is rather variable in form (perhaps because the lorica is thin and easily distorted) and also in its secondary structure. The mouth is double with an erect inner and a spreading outer collar. In most cases there are reticulations on the lower third of the bowl, and from these a number of vertical anastomosing striæ, about 10–17 across one face, run to, or almost to, the collar. The anastomoses vary, however, and are sometimes so frequent that the whole bowl appears to be reticulated, in which case the structure resembles that of *E. reticulata* (Ostenfeld and Schmidt), Jörgensen. Intermediate cases are also seen. At the lip of the collar the primary structure is coarse and consists of large meshes, but it rapidly becomes very fine. Two varieties of shape are shown in Text-figs. 16 and 16*a*.

Dimensions.—Length 65–77μ ; diameter at mouth 43–48μ and (including collar) 52–54μ.

Epiplocylis constricta, Kofoid and Campbell.

Ptychocylis undella var. c, Brandt, 1906, p. 29, pl. lix, fig. 2 ; 1907, p. 295.
Epiplocylis constricta, Kofoid and Campbell, 1929, p. 177, fig. 333.

Occurrence.—Rare. In August, at the weekly station.

Distribution.—Off Ralum in the western, and also in the eastern, Pacific.

Remarks.—The species agrees closely with Brandt's figure. It is not so straight sided as *E. undella*, and the secondary structure is much finer than in *E. deflexa*.

Dimensions.—Length 90–112μ ; diameter at mouth 60μ ; pedicel 15–24μ.

Epiplocylis exigua, Kofoid and Campbell. Text-fig. 17.

Epiplocylis exigua, Kofoid and Campbell, 1929, p. 178, fig. 337.

Occurrence.—Rare. Occurred only in Trinity Opening, a passage through the Great Barrier Reef.

Distribution.—The Pacific, in the South Equatorial Drift and the Peruvian Current.

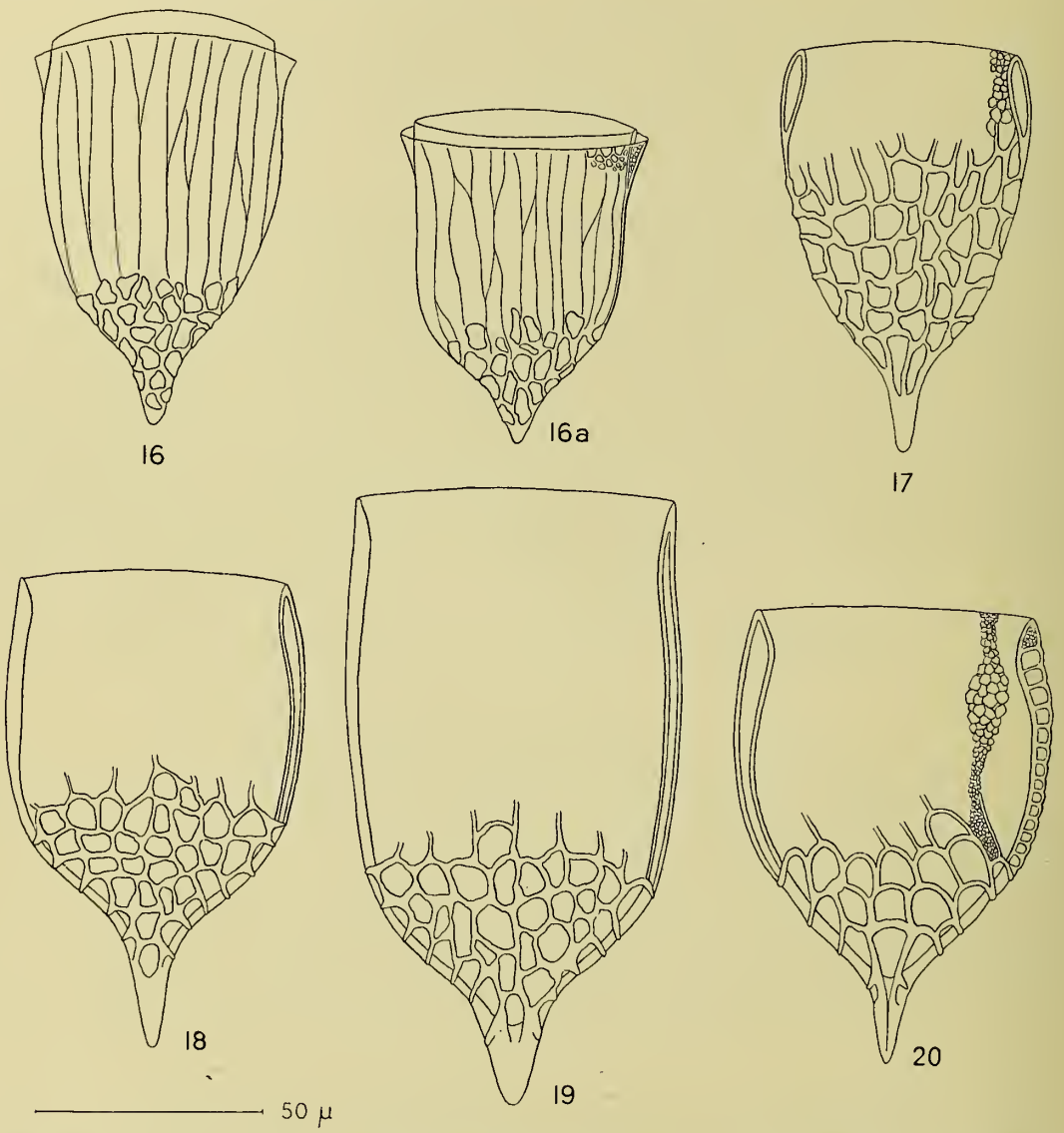
Remarks.—This rare form resembles both *E. exigua*, Kofoid and Campbell, and *E. labiosa*, Kofoid and Campbell (*Ptychocylis calyx*, var. b, Brandt, 1906, pl. lviii, figs. 13, 13*a*). I have put it in the former species because of the longer and more gradual sub-oral thickening, and because the reticulation is absent on the upper quarter of the bowl (·25–·40 in *E. exigua*, ·20 in *E. labiosa*, according to Kofoid and Campbell).

Dimensions.—Total length 88μ ; diameter at mouth 48μ ; pedicel 22μ.

Epiplocylis blanda (Jörgensen), Kofoid and Campbell. Text-fig. 19.

Epiplocylis undella var. *blanda*, partim, Jörgensen, 1924, p. 54, fig. 62.
Epiplocylis blanda, Kofoid and Campbell, 1929, p. 176, fig. 341.

Occurrence.—In Papuan Pass and off Lizard Island in February; rarely at the weekly station in February and March.



Text-figs. 16–20.—16, 16*a*. *Epiplocylis healdi*. 17. *E. exigua*. 18. *E. undella*. 19. *E. blanda*. 20. *E. deflexa*.

Distribution.—The Mediterranean; the Sargasso Sea.

Remarks.—This species is the largest of the genus *Epiplocylis* in these waters. The lower part of the bowl is covered with strong coarse reticulations, which end in free, vertical ribs. The upper two-thirds is covered with very fine reticulations, which are slightly larger in the middle of the bowl.

Dimensions.—Length 120–155μ; diameter at mouth 65–90μ, usually about 70μ; pedicel 26–32μ.

Epiplocylis undella (Ostenfeld and Schmidt). Text-fig. 18.

Cittarocylis Undella, Ostenfeld and Schmidt, 1902, p. 181, fig. 30.
Epiplocylis undella, Kofoid and Campbell, 1929, p. 185, fig. 345.

Occurrence.—In Papuan Pass and off Lizard Island in February; rare at the weekly station in September and March.

Distribution.—The Mediterranean; the Red Sea; the Atlantic.

Remarks.—This species differs from *E. blanda* only in its smaller size.

Dimensions.—Length 103–112μ; diameter at mouth 56–62μ; length of pedicel 26–30μ.

Epiplocylis deflexa, Kofoid and Campbell. Text-fig. 20.

Ptychocylis undella var. b, Brandt, 1906, p. 29, pl. lix, fig. 3; 1907, p. 295, as var. d.
Epiplocylis deflexa, Kofoid and Campbell, 1929, p. 178, fig. 334.

Occurrence.—In Papuan Pass in February and at the weekly station in March.

Distribution.—New Pomerania and the eastern Pacific.

Remarks.—This is an oceanic form found only rarely inside the Great Barrier Reef. It is smaller and more angular than the two preceding species, and the reticulation over most of the bowl is much coarser. The free ribs are directed to the left. The shape is sometimes less angular than shown.

Dimensions.—Length 95–112μ; diameter at mouth 56–73μ; pedicel 16–24μ.

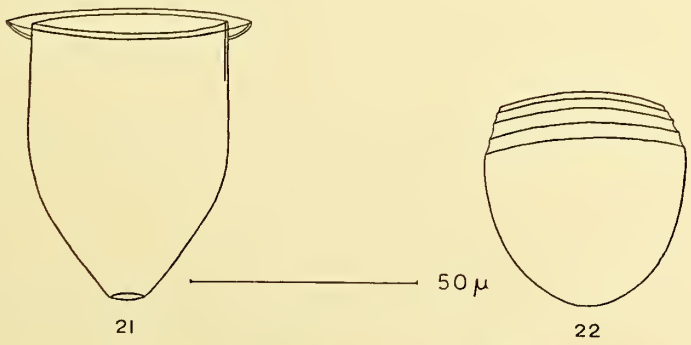
Craterella aperta, n. sp. Text-fig. 21.

Occurrence.—Rare. In January and March at the weekly station, in Papuan Pass and off Lizard Island.

Distribution.—The Great Barrier Reef region.

Description.—The lorica is campanulate, almost cylindrical in the upper third to half, then contracting to an aboral opening. There is a double collar, the outer one flaring and the inner erect. The wall is thin and hyaline. This species differs from all others of the genus *Craterella* in the possession of a wide aboral opening.

Dimensions.—Length 56–65μ; diameter of mouth (inner collar) 43–45μ; diameter of outer collar 52–55μ; aboral opening 7–9μ.



Text-figs. 21, 22.—21. *Craterella aperta*. 22. *Metacylis corbula*.

Metacylis corbula, Kofoid and Campbell. Text-fig. 22.

Metacylis corbula, Kofoid and Campbell, 1929, p. 199, fig. 376.

Occurrence.—Rare. In December and March at the weekly station and off Lizard Island in February.

Distribution.—The Bay of Panama.

Remarks.—The lorica is as wide as long, and is broadly rounded aborally. The collar, on which there are four or five spiral turns, contracts a little towards the mouth.

Dimensions.—Total length 39–43μ ; diameter at mouth 36–38μ ; greatest diameter 42–44μ ; height of collar about 8μ.

Protorhabdonella simplex (Cleve), Jörgensen.

Cyttarocylis simplex, Cleve, 1900, p. 972, fig. (7).
Protorhabdonella simplex, Kofoid and Campbell, 1929, p. 208, fig. 395.

Occurrence.—It was present during most of the year and was common from May to July, but it was scarce or absent from January to April.

Distribution.—The warm regions of the Atlantic ; the coast of Chile ; the Red Sea and Arabian Gulf ; the Gulf of Siam.

Remarks.—One of the commoner species in the Great Barrier Reef material and frequent in water samples. There are about 7–10 vertical ribs, which do not quite reach the mouth, and the slightly flaring oral rim is marked by a spiral line. The specimens are slightly longer than Jörgensen's, measuring 58–69μ in length compared with his 52–58μ.

Dimensions.—Length 58–69μ ; diameter at mouth 32–38μ.

Protorhabdonella curta (Cleve), Jörgensen.

Cyttarocylis striata, forma *β curta*, Cleve, 1901, p. 922, fig. 3*b*.
Protorhabdonella curta, Kofoid and Campbell, 1929, p. 207, fig. 393.

Occurrence.—Rare. In August, September, March and April at the weekly station and off Lizard Island in February.

Distribution.—The Red Sea ; the southern Atlantic ; the Indian Ocean ; the Mediterranean.

Remarks.—This is a smaller species than the last, and has more numerous though less strongly-marked ribs, which often take a spiral course, especially near the mouth. It is of the same general shape as *P. simplex*.

Dimensions.—Length 39–52μ ; diameter at mouth 24–28μ.

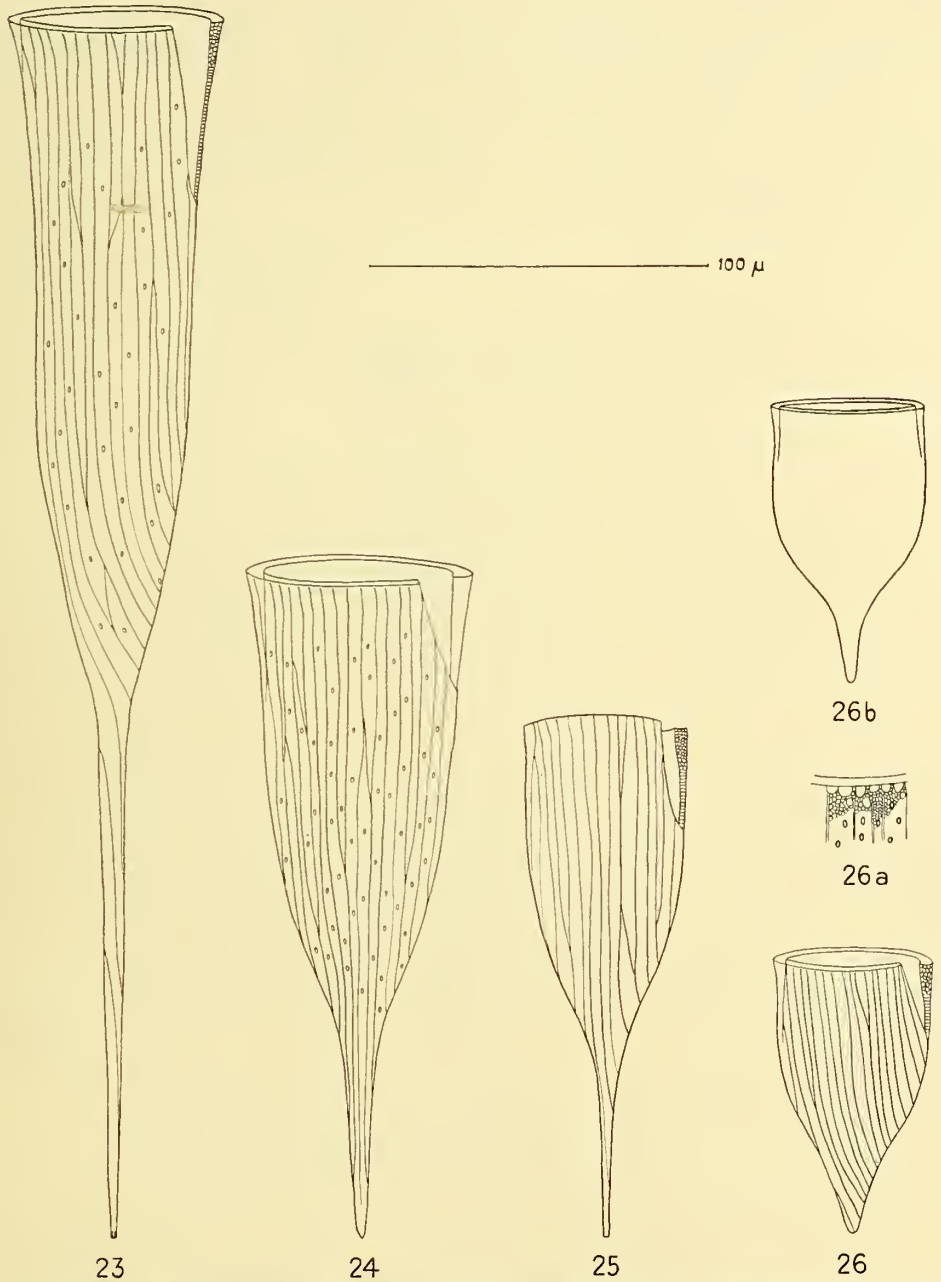
Rhabdonella spiralis (Fol), Brandt. Text-fig. 23.

Ptychocylis (*Rhabdonella*) *spiralis* var. c *indopacifica*, partim, Brandt, 1906, p. 27, pl. liii, figs. 8–10 ;
Rhabdonella spiralis var. c *indopacifica*, Brandt, 1907, p. 326.
Rhabdonella spiralis, Kofoid and Campbell, 1929, p. 219, fig. 414.

Occurrence.—One of the common species in the lagoon of the Great Barrier Reef. It was numerous in July, August and September, and occurred throughout the year, except in December.

Distribution.—Apparently a cosmopolitan species, occurring in the Mediterranean and in the warmer regions of the Atlantic, Indian and Pacific Oceans.

Remarks.—*R. spiralis*, as described by Brandt, was a comprehensive species, con-



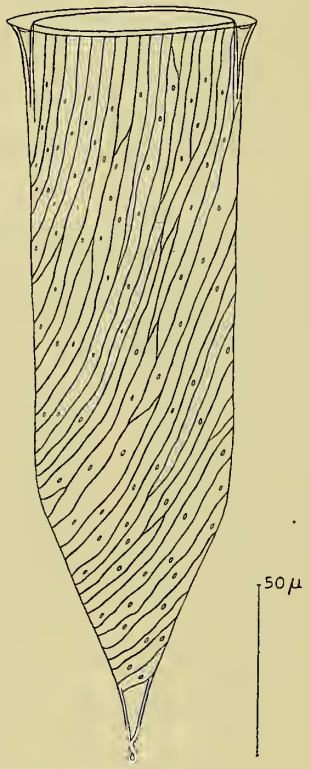
Text-figs. 23–26.—23. *Rhabdonella spiralis*. 24. *R. brandti*. 25. *R. quantula*. 26, 26*a*, 26*b*. *R. amor*.

taining a number of varieties. It has recently been split up by Kofoid and Campbell into a considerable number of new species, some corresponding partly or entirely to Brandt's varieties. Until their full descriptions are published it is not possible to find out on what differences their species are founded. Jörgensen (1924) considers that there is

a great deal of individual variation in the species, and this is confirmed by the Great Barrier Reef material.

The present form agrees well with Brandt's figure of *R. spiralis* var. *indopacifica* and with Jörgensen's *R. spiralis* (1924, fig. 68). It has an oral flare (not always well-marked) and gutter ; it is almost cylindrical above and tapering below, and has a long slender pedicel almost half the total length and open at the tip. The striæ run vertically at the top of the bowl and slightly left-handed on its foot. Numerous fenestræ are present between the ribs and the structure of the wall is usually fine.

Dimensions.—Length 266–411μ ; length of pedicel 95–224μ ; outside diameter of mouth 67–73μ ; number of ribs 30–40.



27

Text-fig. 27.—*Rhabdonella spiralis ?*

Rhabdonella spiralis (Fol), Brandt ? Text-fig. 27.

A form found only once, at the weekly station in August, may be a monstrous or a half-developed specimen, such as is described by Jörgensen (1924). The ribs, about 40 in number, run right-handed on the bowl (which is unusual in *Rhabdonella* spp.). There are numerous fenestrae, except just below the mouth. The shape of the bowl resembles that of *R. spiralis*, but it narrows rather abruptly to a short pedicel.

Dimensions.—Total length 215μ ; external diameter of mouth 73μ ; pedicel 13μ.

Rhabdonella brandti, Kofoid and Campbell. Text-fig. 24.

Ptychocylis (*Rhabdonella*) *amor* var. a *cuspidata*, Brandt, 1906, p. 27 ; pl. liv, figs. 3, 10, 11 ; Brandt, 1907, *Rhabdonella amor* var. *cuspidata*, p. 331.
Rhabdonella brandti, Kofoid and Campbell, 1929, p. 213, fig. 400.

Occurrence.—Present throughout most of the year, but was much more abundant after March.

Distribution.—In the warm parts of the Atlantic ; the Karajak fjord ; the Mediterranean ; the Red Sea ; off Borneo.

Remarks.—This is a smaller form than the preceding, and shows similar slight variations in size and shape. The ribs usually run vertically, but occasionally show a slight left-handed spiral on the foot of the bowl. The oral flare is little marked. The fenestrae are numerous and distinct.

Dimensions.—Length 158–198μ, usually 170–190μ, of which the pedicel forms from a quarter to a little less than half ; external diameter at mouth 60–69μ ; about 28–35 ribs, fenestrae numerous.

Rhabdonella quantula, Kofoid and Campbell. Text-fig. 25.

Rhabdonella quantula, Kofoid and Campbell, 1929, p. 218, fig. 402.

Occurrence.—Appeared mostly at stations near the outer reefs, especially in Papuan Pass, but was present at the weekly station in September and October, and once in March.

Distribution.—The Mexican, Californian, South Equatorial, Equatorial Counter and North Equatorial Currents ; the Panamic area, Galapagos Eddy and South Equatorial Drift.

Remarks.—This species is like *R. brandti* in general appearance, but is more slenderly built and has a better defined pedicel. Its range of size is greater, but on the whole the specimens are smaller. The ribs are vertical or slightly left-handed, the tip of the pedicel is usually open and fenestrae are often present, although sometimes faint and difficult to see. The ribs are fewer than in Kofoid and Campbell's specimens. It is apparently restricted to more oceanic conditions than *R. brandti* and *R. spiralis*.

Dimensions.—Length 104–172μ ; outside diameter at mouth 40–52μ ; number of ribs 20–35, usually 30–35.

Rhabdonella amor (Cleve), Brandt. Text-fig. 26.

Cittarocylis Amor, Cleve, 1900, pp. 970-971, fig. (4).
Rhabdonella amor, Kofoid and Campbell, 1929, p. 212, fig. 398.

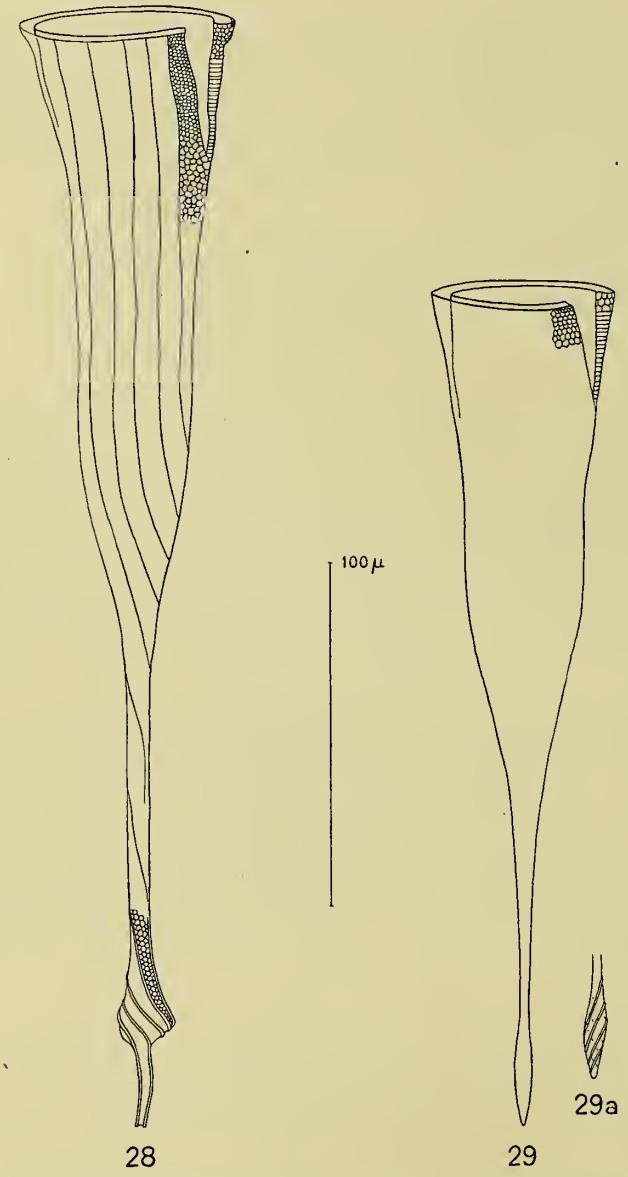
Occurrence.—Present throughout the year at the weekly station, more commonly after March, and also at the stations on the Outer Barrier Reefs.

Distribution.—Widely distributed in the warmer parts of the Atlantic and in the Indian Ocean, the Mediterranean and the Karajak fjord.

Remarks.—This is the smallest of the *Rhabdonella* species in the Great Barrier Reef material. It varies in shape, but the pedicel, although better defined than in Kofoid and Campbell's figure, is not usually so well marked off as in the other species. Text-figs. 26 and 26*b* show variations in shape ; the pedicel is sometimes even less marked than in Text-fig. 26. The oral flare is only slight. There are 30–44 ribs, usually running in a

left-handed spiral on the foot of the bowl. The fenestrae, when present, are small and sometimes difficult to see. In many specimens the meshes at the oral lip are large (Text-fig. 26*a*), but these rapidly give way to small meshes and the structure over most of the bowl is very fine.

Dimensions.—Length 77–92μ ; external diameter of mouth 45–55μ.



Text-figs. 28, 29.—28. *Rhabdonellopsis intermedia.* 29, 29*a*. *Xystonella lanceolata.*

Rhabdonellopsis intermedia, Kofoid and Campbell. Text-fig. 28.

Rhabdonellopsis intermedia, Kofoid and Campbell, 1929, p. 223, fig. 424.

Occurrence.—Rare. Present at the weekly station in August, September and October, 1928, in March and June, 1929, and at most stations on the outer Barrier. It is thus confined to water of a fairly high salinity.

Distribution.—The Pacific Ocean in the Californian, Mexican, Peruvian and South Equatorial Currents; the Panamic area and Galapagos Eddy.

Remarks.—The genus *Rhabdonellopsis* is widely distributed in warm oceanic waters. It has been divided by Kofoid and Campbell into six species, of which the present forms most closely resemble *R. intermedia*. They resemble also Brandt's *Rhabdonella apophysata* var. *b*, except in the occasional presence of fenestrae, which seems to be a variable character, and in the striae, which are less spirally twisted.

The oral flare is marked; the ribs, 12–17 in number, are almost vertical, showing only a slight left-handed twist on the foot of the bowl and the pedicel. They continue to the knob, where they are often well marked. The pedicel is open at the tip. The development of the knob on the pedicel varies considerably, from a simple knob to a structure 14μ in diameter, with well-marked ribs and secondary mesh-work.

On the bowl the secondary structure is very fine at the oral lip, enlarges on the body to a coarse hexagonal mesh-work, and diminishes again on the pedicel.

Dimensions.—Length 240–370μ (usually 250–300μ); external diameter at mouth 60–75μ; pedicel 116–180μ (usually 116–140μ); fenestrae few and small, not always visible; diameter of knob 9–14μ.

Xystonella lanceolata (Brandt), Brandt. Text-fig. 29.

Cytarotcylis ? (*Xystonella*) *lanceolata*, partim, Brandt, 1906, pp. 7, 24, pl. xlii, fig. 4–7; (*Cyttarocylis ?*) *Xystonella lanceolata*, Brandt, 1907, p. 258.
Xystonella lanceolata, Kofoid and Campbell, 1929, p. 236, fig. 449.

Occurrence.—Rare. Only in August, September and October and at stations on the Great Barrier Reef.

Distribution.—The Atlantic and Indian Oceans; the Mediterranean.

Remarks.—This species is rather variable in form. The oral flare is sometimes present and sometimes not. The pedicel is always more refractive than the very delicate upper part of the lorica, and stands out from it clearly. The secondary mesh-work, always visible in these specimens as in Jörgensen's (1924), is very small near the mouth, large over the greater part of the bowl and diminishes towards the pedicel. On this, when visible, the meshes are longer in shape. The pedicel is usually enlarged into a spindle-shaped swelling near the foot, on which the ribs run diagonally (Text-fig. 29*a*) or form a mesh-work, but occasionally the swelling shows no structure, and it may be entirely absent.

Dimensions.—Length 215–275μ; external diameter of mouth 53–60μ; pedicel 65–95μ.

Xystonella treforti (Daday), Laackmann.

Cyttarocylis Treforti, Daday, 1887, p. 597, pl. xxi, fig. 1.
Xystonella treforti, Kofoid and Campbell, 1929, p. 238, fig. 452.

Occurrence.—Very rare. In Papuan Pass, and off Lizard Island, in February, and once at the weekly station in March.

Distribution.—Mediterranean, Atlantic, Indian and Pacific Oceans.

Remarks.—This is a larger species than the last, and agrees well with Brandt's description and figure (Brandt, 1906, pl. xlviii, fig. 1).

Dimensions.—Length 405–469μ; external diameter of mouth 76–80μ; greatest diameter of body 75–86μ.

Undella hemispherica, Laackmann. Text-fig. 30.

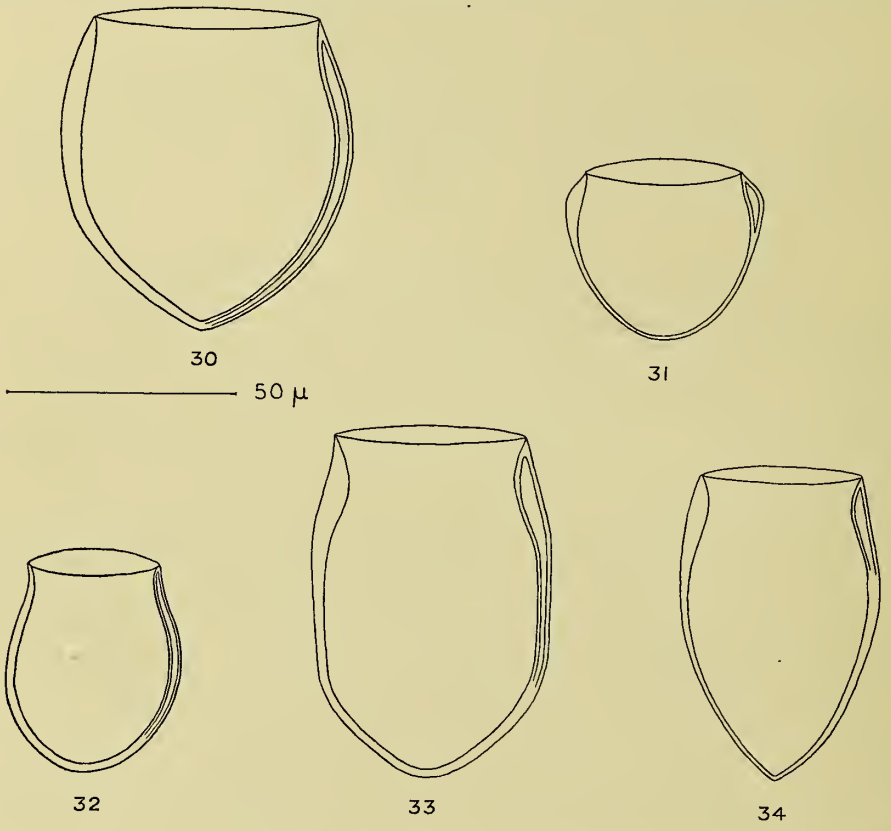
Undella hemispherica, Laackmann, 1910, pp. 468, 471, 472–3, 493, pl. xlix, fig. 22.
Undella hemispherica, Kofoid and Campbell, 1929, p. 263, fig. 505.

Occurrence.—Very rare. In October and March at the weekly station and off Lizard Island in February.

Distribution.—The tropical Atlantic.

Remarks.—This rare form resembles a *Proplectella*, but has no thickening of the wall to form an inner collar, and is almost as wide as long. A fine primary reticulation can be made out, especially near the mouth.

Dimensions.—Length 65–69μ ; diameter at mouth 47–53μ ; greatest width 62–65μ.



Text-figs.—30–34.—30. *Undella hemispherica*. 31. *U. turgida*. 32. *Proplectella perpusilla*. 33. *P. tenuis*. 34. *P. acuta*.

Undella turgida, Kofoid and Campbell. Text-fig. 31.

Undella turgida, Kofoid and Campbell, 1929, p. 266, fig. 502.

Occurrence.—Very rare. One specimen seen from the catch off Lizard Island in February.

Distribution.—The eastern tropical Pacific.

Remarks.—The single specimen seen agreed exactly with Kofoid and Campbell's figure except that it was slightly smaller and had a distinct reticulation, the meshes being small at the oral lip, and slightly larger at the widest part of the bowl.

Dimensions.—Length 37μ ; diameter at mouth 35μ.

Proplectella tenuis, Kofoid and Campbell. Text-fig. 33.

Undella claparèdei var. c, Brandt, 1906, p. 31, pl. lxiv, figs. 5, 6, 7 ; 1907, pp. 348, 349, 363, 364.
Proplectella tenuis, Kofoid and Campbell, 1929, p. 283, fig. 536.

Occurrence.—Rare except from February till May and at stations on the outer barrier. It was then present only in small numbers.

Distribution.—The tropical Atlantic ; the Indian Ocean south of Madagascar.

Remarks.—This was the commonest species of the genus *Proplectella* in the Great Barrier Reef material. The lorica is ovate, expanding below the mouth to its widest at about a third of the length from the mouth. The sides are slightly flattened, and the aboral end is usually rounded, sometimes slightly angular. A fine reticulation can be made out in most specimens.

Dimensions.—Length 69–76μ ; diameter at mouth 40–45μ ; greatest width 49–56μ.

Proplectella perpusilla, Kofoid and Campbell. Text-fig. 32.

Proplectella perpusilla, Kofoid and Campbell, 1929, p. 281, fig. 524.

Occurrence.—Very rare. In March and April at the weekly station.

Distribution.—The Galapagos Eddy and widely in the eastern tropical Pacific.

Remarks.—This is a smaller form than the last and is widest in the expanded aboral half. Only a few specimens were seen.

Dimensions.—Length 47–49μ ; diameter at mouth 27–30μ ; greatest width 37–38μ.

Proplectella acuta (Jörgensen). Text-fig. 34.

Undella subacuta forma *acuta*, Jörgensen, 1924, pp. 39–41, fig. 43*a*.
Proplectella acuta, Kofoid and Campbell, 1929, p. 273, fig. 545.

Occurrence.—Very rare. In October at the weekly station.

Distribution.—The Mediterranean.

Remarks.—This species differs from the others in the genus in its acutely pointed aboral end. The wall is much thinner in the aboral than in the oral half. Only a single specimen was seen.

Dimensions.—Length 65μ ; diameter at mouth 38μ ; greatest diameter 47μ.

Dictyocysta reticulata, Kofoid and Campbell.

Dictyocysta Templum, Daday, 1887, p. 585, pl. xxi, figs. 8, 9.
Dictyocysta reticulata, Kofoid and Campbell, 1929, p. 300, fig. 560.

Occurrence.—Rare. Found at the weekly station in March, April and May, and in samples from Trinity Opening and Papuan Pass.

Distribution.—The Mediterranean ; the Indian Ocean ; the eastern tropical Pacific.

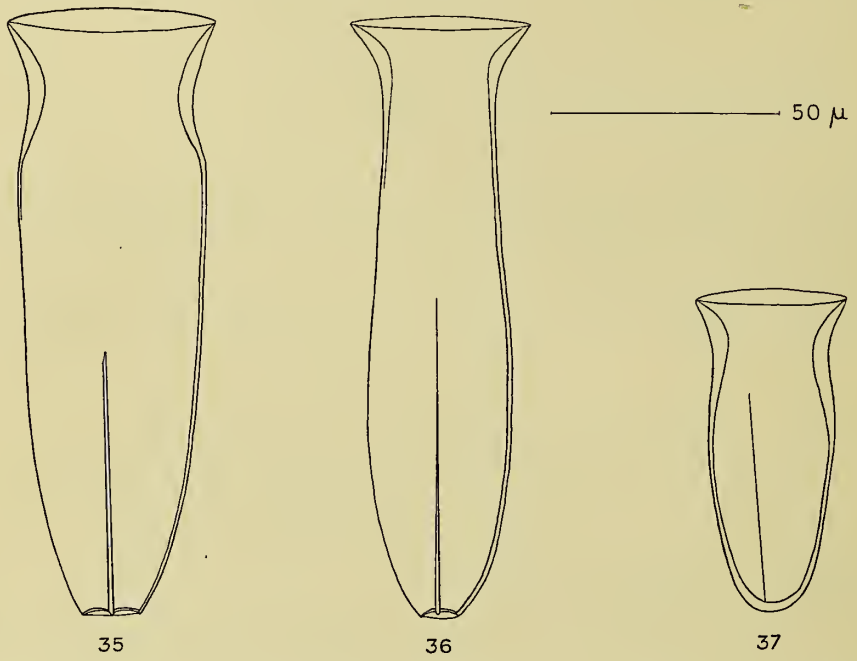
Remarks.—There is a good figure of this species in Brandt (1906, pl. iii, fig. 8). The collar is a little more than a third of the whole length, and the bowl is widest just below the collar and is bluntly pointed aborally. There are usually 6, but occasionally 7, large angular windows in the collar. A little below the widest part of the bowl there are usually two circles of fenestrae. Sometimes, however, only one circle is present, and

occasionally there are no fenestrae at all. The number in each circle is variable, the top one having 6 to 9, and the lower usually only 2 or 3, smaller and less regular. This lower incomplete circle is not mentioned by Kofoid and Campbell, although there is an indication of it in Brandt's fig. 8 and in Daday's fig. 8. The rest of the bowl is made up of very regular polyhedral reticulations. One specimen showed very small projections all along the oral margin of the collar.

Dimensions.—Total length 58–65μ ; diameter at mouth 37–43μ ; height of collar 20–25μ ; length of bowl 34–45μ ; greatest width of bowl 43–48μ.

Amphorella quadrilineata (Claparède and Lachmann), Daday. Text-fig. 35.

Tintinnus quadrilineatus, Claparède and Lachmann, 1858, p. 201, pl. ix, fig. 3.
Amphorella quadrilineata, Kofoid and Campbell, 1929, p. 311, fig. 587.



Text-figs. 35–37.—35. *Amphorella quadrilineata.* 36. *A. brandti.* 37. *A. minor.*

Occurrence.—Present throughout the year and was common in February and March.

Distribution.—Has a wide distribution in northern temperate waters, as well as in the Mediterranean and the warm parts of the Atlantic, Indian and Pacific Oceans.

Remarks.—This species has three well-marked fins, which run from the aboral end up towards the mouth. Their length is variable ; usually they extend half or two-thirds of the way up, but they occasionally run right up to the mouth. The lorica narrows, and its wall is much thickened just below the mouth. It is widest in the upper third, a little below the neck, and narrows gradually to a truncated tip. Although this thickening of the wall of the lorica is very characteristic, it varies considerably and may occasionally be quite absent.

Dimensions.—Total length 108–145μ (usually over 130μ) ; diameter at mouth 45–54μ ; diameter at neck 37–43μ ; greatest diameter of body 38–43μ.

Amphorella brandti, Jörgensen. Text-fig. 36.

Tintinnus amphora, Brandt, 1906, p. 33, pl. lxix, fig. 6 ; 1907, partim, pp. 433–434.
Amphorella brandti, Kofoid and Campbell, 1929, p. 309, fig. 588.

Occurrence.—Present throughout the year and was common in February and March.

Distribution.—The Atlantic ; Mutsu Bay in Japan.

Remarks.—This species is a more slender form than the preceding, flares more towards the mouth and is usually rather longer. Although the dimensions of the oral part remain pretty constant, the length varies considerably. Three fins are present, as in the last species. The lorica is widest in its lower third, and then narrows to a truncated tip. No primary or secondary structure was ever visible.

Dimensions.—Total length 107–190μ (usually 130–160μ) ; diameter at mouth 38–45μ ; diameter at neck 22–28μ ; greatest diameter of body 29–35μ.

Amphorella laackmanni, Jörgensen.

Tintinnus amphora var. *dadayi*, Laackmann, 1910, pp. 486–487, 493, pl. l, fig. 12.
Amphorella laackmanni, Kofoid and Campbell, 1929, p. 310, fig. 591.

Occurrence.—Very rare. Off Lizard Island in February, and at the weekly station in March.

Distribution.—The Mediterranean ; the tropical Atlantic.

Remarks.—The few specimens seen were longer than Jörgensen's (1924, p. 19, fig. 14) from the Mediterranean (from the stomach of Salps), but agree with his description otherwise. The four ribs from the oral end do not join up with the four from the aboral end.

Dimensions.—Length 75–84μ ; diameter at mouth 20–22μ.

Amphorella minor, Jörgensen. Text-fig. 37.

Amphorella quadrilineata var. *minor*, Jörgensen, 1924, p. 18, figs. 12*a* and 12*b*.
Amphorella minor, Kofoid and Campbell, 1929, p. 310, fig. 590.

Occurrence.—Very rare. In September and October, 1928, and in July, 1929, at the weekly station.

Distribution.—The Mediterranean and the eastern Pacific.

Remarks.—Apart from its small size and the fact that it has a rounded instead of a truncated end, this species is very like *A. quadrilineata*. It thus resembles Jörgensen's drawing rather than Kofoid and Campbell's, which is more like a small *A. brandti*.

Steenstrupiella steenstrupii (Claparède and Lachmann).

Tintinnus Steenstrupii, Claparède and Lachmann, 1858, p. 200, pl. viii, fig. 5.
Steenstrupiella steenstrupii, Kofoid and Campbell, 1929, p. 314, fig. 596.

Occurrence.—Rare. In September, October, November, March and April at the weekly station, and in Trinity Opening in November.

Distribution.—Widely distributed in the Mediterranean, Atlantic and Indian Oceans.

Remarks.—This species is very variable, both in length and in thickness of wall. There is a marked oral flare and sub-oral thickening. The wall of the lorica is usually thick for about two-thirds of the length, but thins out at the aboral end. No striae were visible on about half the specimens, but they were quite clear on the rest.

In general appearance this form agrees with *S. robusta*, Kofoid and Campbell, but occasionally the wall was quite thin, even at the neck (*cf. Amphorella quadrilineata*), and all gradations were found between this and the usual condition. There was no relation between size or presence of striae and thickness, so I prefer to identify all specimens as *S. steenstrupii*. As usual in the family Tintinnidae, the width of the mouth, neck and body generally is much more constant than the total length.

Dimensions.—Length 84–197μ ; diameter at mouth 34–37μ ; diameter at neck 20–24μ ; greatest diameter 13–19μ.

Steenstrupiella intumescens (Jörgensen).

Amphorella intumescens, Jörgensen, 1924, p. 21, fig. 19.
Steenstrupiella intumescens, Kofoid and Campbell, 1929, p. 313, fig. 594.

Occurrence.—Rare. It was seen only in March at the weekly station.

Distribution.—The Mediterranean.

Remarks.—The lorica is long and narrow, with a flaring mouth and a rounded aboral end. Four striae or fins extend from about the middle to the aboral end. In the two specimens described by Jörgensen there was a marked thickening of the wall in the middle of the lorica, which merged gradually into the thin-walled parts above and below. In the present material this thickening is absent in some specimens. The oral end differs from all others in the genus by the complete lack of a sub-oral thickening of the wall.

Dimensions.—Length 172–238μ ; diameter at mouth 34–37μ ; diameter of body in the middle 17–21μ ; length of fins 77–90μ.

Amphorellopsis acuta (Schmidt).

Amphorella acuta, Schmidt, 1902, p. 184, figs. 2*a–c*.
Amphorellopsis acuta, Kofoid and Campbell, 1929, p. 315, fig. 598.

Occurrence.—Rare. At the weekly station in September, October, November, February and March, and off Lizard Island and in Papuan Pass in February.

Distribution.—The Gulf of Siam ; the West African coast.

Remarks.—This species is very like *Amphorella brandti*, except that it is smaller in all dimensions and has a pointed, not a truncated, aboral end. The thickness of the wall is variable.

Dimensions.—Length 76–89μ ; diameter at mouth 29–37μ ; diameter of neck 19–24μ ; greatest diameter of body 22–27μ.

Four longer specimens were seen. Their dimensions were : Length 116–121μ ; diameter at mouth 34–36μ ; diameter of neck 19–25μ ; greatest diameter of body 26–30μ.

Dadayiella ganymedes (Entz Sr.), Kofoid and Campbell.

Tintinnus Ganymedes, Entz Sr., 1884, p. 409, pl. xxiv, figs. 17, 18.
Dadayiella ganymedes, Kofoid and Campbell, 1929, p. 321, fig. 610.

Occurrence.—Rare until November, and was usually present at the weekly station thereafter.

Distribution.—The Mediterranean; widely distributed in the Atlantic; the Indian and Pacific Oceans.

Remarks.—A very delicate species. The ribs number 7–12 and there are sometimes subsidiary shorter ribs between these. None of them extend below the widest part of the bowl. Occasionally the wall of the lorica at the mouth appears to have been destroyed and the ribs are seen sticking out. No marking was observed on the thin-walled pedicel, which is straight and sharply pointed. The length is less than that of the specimens described by Entz from the Mediterranean, and Brandt from the Atlantic. Apart from this, and the lack of ribs on the pedicel, the specimens resemble Brandt's pl. lxx, fig. 2.

Dimensions.—Total length 75–95μ; diameter at mouth 29–30μ; greatest width of bowl 28–30μ; length of pedicel 13–17μ.

Tintinnus attenuatus, Kofoid and Campbell. Text-fig. 38.

Tintinnus lusus-undae var. c, Brandt, 1906, partim, p. 32, pl. lxv, fig. 12; 1907, p. 422, *Tintinnus fraknoi* var. c, 1906, p. 32, pl. lxv, fig. 20; 1907, partim, p. 424.
Tintinnus attenuatus, Kofoid and Campbell, 1929, p. 332, fig. 633.

Occurrence.—Present throughout most of the year except from April to June, but not so common as *T. lusus-undae*.

Distribution.—The Mediterranean; the tropical Atlantic; the Indian Ocean off Madagascar; the western Pacific.

Remarks.—This species agrees well with Brandt's *T. fraknoi* var. c, which has been divided by Kofoid and Campbell between two species, *T. attenuatus* and *T. macilentus*. I have put the present form in the first of these, since it agrees more closely in size, but it usually possesses a slight aboral flare—a feature which, according to Brandt's description (1907, p. 424), was usually present, but might be little marked. This is, however, a variable character (*cf. T. lusus-undae*). The oral funnel is not marked, for the flare is gradual, and it thus resembles Brandt's pl. lxv, fig. 20, rather than pl. lxv, fig. 12. Text-figs. 38 and 38*a* show two specimens with the aboral flare more marked in one than in the other.

The diameter of both oral and aboral end is less than in other similar species (*T. fraknoii*, Daday, *T. elongatus*, Jörgensen).

Dimensions.—Length 228–410μ (usually 320–400μ); diameter at mouth 52–57μ; aboral diameter 17–29μ.

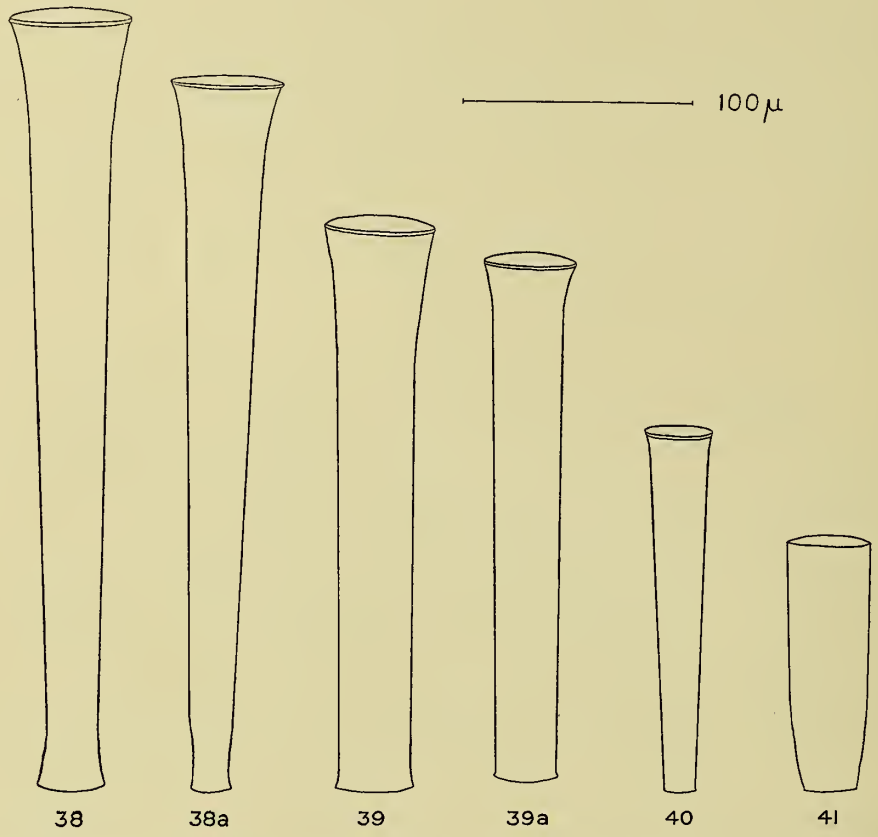
Tintinnus lusus-undae, Entz Sr. Text-fig. 39.

Tintinnus Lusus-undae, Entz Sr., 1885, p. 202, pl. xiv, fig. 12.
Tintinnus lusus-undae, Kofoid and Campbell, 1929, p. 335, fig. 656.

Occurrence.—Present throughout the year and common in August.

Distribution.—The Mediterranean; the tropical Atlantic and the Indo-Pacific region.

Remarks.—Like the rest of the family Tintinnidae, the diameter of this species varies within rather narrow limits, while the length varies considerably. The shape is also variable. The lorica has the form of an open tube, wider at the oral than at the aboral end, but the amount of oral flare varies; there is sometimes a marked brim at the oral edge; the aboral end is usually straight, but there is sometimes a slight flare.



Text-figs. 38–41.—38, 38*a*. *Tintinnus attenuatus*. 39. *T. lusus-undae*. 39*a*. *T. lusus-undae* (slender form). 40. *T. stramentus*. 41. *T. pacificus*.

Fifty specimens were measured and it was found that the measurements fell into two groups. Within each group the total length, the presence or absence of a brim and the amount of oral and aboral flare were equally variable, but one group (Text-fig. 39*a*) was more slender than the other (Text-fig. 39). It is possible that a second species is present (perhaps *T. tenue*, Kofoid and Campbell), but in view of the resemblances otherwise and the fact that a few intermediate specimens were found the two forms are at present kept as one species. The dimensions of the wider form agree well with those of *T. lusus-undae* from elsewhere.

Dimensions.—Wide form: Length 176–298μ; diameter at mouth 51–59μ (usually 52–54μ); diameter at foot 29–35μ (usually 30–33μ); diameter across middle of body 35–43μ (usually 38–39μ).

Slender form: Length 155–277μ; diameter at mouth 34–46μ (usually 43–45μ); diameter at foot 24–29μ (usually 24–27μ); diameter across middle of body 29–33μ (usually 30–32μ).

Intermediate forms: Length 183–191μ; diameter at mouth 47–49μ; diameter at foot 29–30μ; diameter across middle of body 34μ.

Tintinnus stramentus, Kofoid and Campbell. Text-fig. 40.

Tintinnus stramentus, Kofoid and Campbell, 1929, p. 339, fig. 635.

Occurrence.—Appeared occasionally throughout the year, but was not seen after February.

Distribution.—The California Current; the Mexican Current; the Panamic area and South Equatorial Drift of the Pacific.

Remarks.—This species is like a small and slender *T. attenuatus*, but it lacks the oral flare and has only a well-marked brim. The aboral end has usually a very slight flare, but this is sometimes lacking. The sides are straight. Of the specimens measured, several are considerably shorter than the rest, but since the oral dimensions and general shape are the same, they also probably belong to this species.

Dimensions.—Typical: Length 142–176μ; oral diameter 30–31μ; aboral diameter 13–16μ. Others: Length 101–129μ; oral diameter 26–31μ; aboral diameter 11–19μ.

Tintinnus pacificus, Kofoid and Campbell. Text-fig. 41.

Tintinnus pacificus, Kofoid and Campbell, 1929, p. 337, fig. 632.

Occurrence.—Very rare. Occurred in November at the weekly station.

Distribution.—The eastern Pacific, in the South Equatorial Drift.

Remarks.—The few specimens seen were longer than Kofoid and Campbell's specimens, but agree well in general shape. The lorica is almost cylindrical in the oral half or two-thirds, and then usually contracts to an aboral opening about two-thirds the diameter of the oral opening.

Dimensions.—Length 108–120μ; diameter at mouth 33–43μ; diameter at foot 22–27μ.

Tintinnus apertus, Kofoid and Campbell.

Tintinnus inquilinus, Claparède and Lachmann, 1858, pp. 196–198, pl. viii, fig. 2.
Tintinnus apertus, Kofoid and Campbell, 1929, p. 331, fig. 648.

Occurrence.—Present at the weekly station from October to April. It is a neritic form, and appears when the other neritic species, *Tintinnopsis* spp. and *Codonellopsis ostenfeldii* are at their commonest.

Distribution.—The coast of Norway; the Mediterranean; the eastern Pacific.

Remarks.—This species is often seen attached to *Chaetoceros* spp. and is figured thus by Daday (1887), but in the Great Barrier Reef material it was always free. It is almost cylindrical in the upper three-quarters or four-fifths of the lorica, and then narrows to an opening about half the width of the mouth.

Dimensions.—Length 85–103μ; oral diameter 28–32μ; aboral diameter 15–17μ.

Daturella luanae, n. sp. Text-fig. 42.

Occurrence.—In Trinity Opening and at the weekly station in November, 1928.

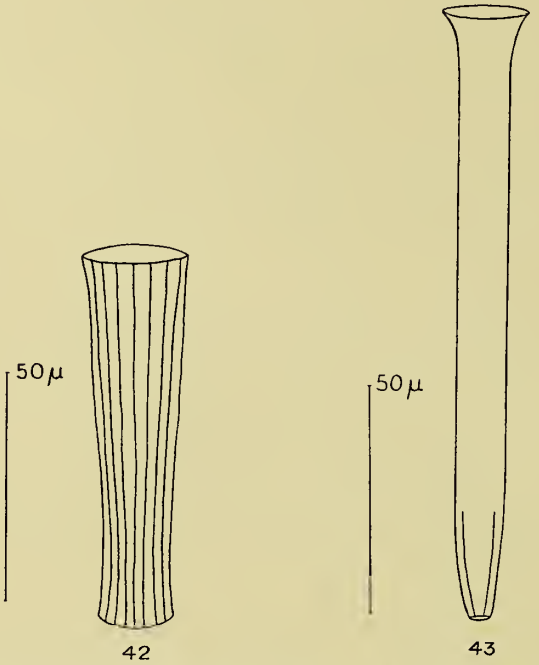
Distribution.—The Great Barrier Reef region.

Description.—The length is about three times the oral diameter. The lorica is thin and easily distorted, but in a normal specimen it is almost cylindrical in the upper half and then contracts slightly in the lower half. There is a slight oral flare. There are about 14 striae, running vertically from the oral to the aboral end.

It differs from all other species of the genus *Daturella* in its much smaller size.

The species is named after the "Luana", the yacht from which most of these hauls were made.

Dimensions.—Length 72–91μ; diameter at mouth 22–31μ (usually 26μ); aboral diameter 15–18μ.



Text-figs. 42, 43.—42. *Daturella luanae*. 43. *Salpingella subconica*.

Salpingella subconica, Kofoid and Campbell. Text-fig. 43.

Salpingella subconica, Kofoid and Campbell, 1929, p. 355, fig. 676.

Occurrence.—Rare. Occasional during the year, but not seen after April.

Distribution.—The eastern Pacific; in the Galapagos Eddy; the Mexican and Peruvian Currents; the Panamic area and the South Equatorial Drift.

Remarks.—Only a few specimens of this rare species were seen in the tow-nettings. It is probably slender enough to slip through the meshes of the net.

It has a flaring mouth and a long cylindrical body contracting aborally to a narrow opening. Six fins are visible on the contracted aboral end.

Dimensions.—Length 97–131μ; oral diameter 16–18μ; aboral opening about 4μ.

Table I.

	Weekly Station.																										Position.				
	Aug.		Sept.		Oct.		Nov.		Dec.		Jan.			Feb.		Mar.			Apr.		May.		June.		July.		Trinity Opening.	Trinity Opening.	Cape Bedford.	Lizard Island.	Papuan Pass.
. . . .	Aug.		Sept.		Oct.		Nov.		Dec.		Jan.			Feb.		Mar.			Apr.		May.		June.		July.		Aug.	Nov.	Feb.	Feb.	Feb.
1 number . .	3	6	10	13	15	18	23	25	32	35	37	38	39	41	42	47	48	51	53	55	57	58	61	63	64	67	8	26	43	44	49
intinnus nordqvisti .		+			+			c	+	+			+			+	c	c					+			+			+	+	
nopsis compressa .		+	+			+		+	+		+					c	+	c					+		+				+	f	
tensenii . .					+	+		c	+				+			+	+	c			+		+	+				+			+	
ndata . . .	+	+		+	+	+	+	+	+	+			f	+		+	+	c	+	+	+	+	+	+	+	+			+	+	+	+
ilis . . .	+	+	+		+	+		c	+		+	+	+	+		+	+	c	+	+	+	+	+	+	+				+	+	+	+
ix . . .			+		+			c	+	+			+			+	+	c	+	+	+		+	+	+	+			+	+		
ndrica . . .		+	+		+	+		c				+	+		+	+	c	c					+	+					+			
ntinensis . .																+	+	+		+										+		
mella nivalis . .						+										+			+											+		
llopsis ostenfeldii .	c	c	+	+	+	+		c	+	+	c	c	+	+	+	+	+	c	c	f		+	+	c	f	+	+		+	+	+	+
ca . . .			+	+		+	+		+	+			+	+	+	+	+	+		f					f	+	+			+	+	+
icollis . .	+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+		f	+			+	+	+	+			+	+	+
icaudata . .																														+		
ocylis scalaria .																															+	
uroides . . .				+			+						+	+		+											+	+			+	
a laciniosa . .																+															+	
azorica . .			+				+		+											+					+			+		+		
ylis ralumensis .																+														+		
li . . .	+	+	+	+		+	+		+	+	+		+		+	+	+			+	f	+	+	+	+	+	+	f		+		f
tricta . . .	+																															
ua . . .																											+					
da . . .															+	+	+													+	+	
lla . . .				+												+	+													+	+	
xa . . .																+															+	
la aperta . .													+			+														+	+	
is corbula . .									+							+														+		
ubdonella simplex .	+	+	+			+		+		+											c	f	+	f	c	f						
ui. . . .																+			+						+					+		
ella spiralis .	+	+	+	+	+	c	+	+					+			+	+	+	+	f	f	+	+	+	+	f	+		+	+	+	
lti . . .		+	+			+	+									+	+	+	+	f	f	+	c	+	c	f			+	+		+
tula . . .			+		+	+										+	+	+											+		+	+
m . . .	+	+		+		+	+	+		+			+	+	+	c	+	+	f	f	f	+	+		+	f			f	+	+	f
ellopsis intermedia	+		+	+		+										+	+						+				+				+	+
lla lanceolata .	+		+			+																					+					
ti . . .																+											+					
hemispherica .						+										+																
da . . .																																
ella tenuis . .						+									+	+	+		+	+	+	+					+			+		f
silla . . .																+			+													
						+																										
sta reticulata .																+			+	+	+						+					+
ella quadrilineata .	+	+	+		+	+				+		+	c	f	c	c	+		+	+			+		+	+			+	+	+	+
lti . . .	+		+		+	+		+		+	+		c	f	c	c	+	+		+		+			+		+			+	+	+
manni . .																+															+	
. . . .			+			+																				+						
piella steenstrupii			+			+	+									+				+												
escens . .																+																
llopsis acuta . .				+		+	+							+	+	f		+												+	+	
la ganymedes .	+					+	+	+	+	+	+	+	+	+	+	c	+	+	+	+		+	+	+	+	+			+	+	+	+	
s attenuatus .			+			+		+	+	+		+	+	+	+	f	+								+	+			+	+	+	
undae . .	+	+	+	+		+				+		+	f	+	+	f	+	+	f	+		+	+	+	+	f	+		+	+	+	+
entus . .	+	+	+		+	+		+	+		+			+		+													+	+	+	+
us . . .							+																									
s . . .						+	+		+			+		+	+	f	+	+			+								+	+		
luanae . .							+																					+					
la subconica .				+				+												+								+				

+ = Present, but not in large numbers. f = frequent. c = Common.

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INDEX

(The principal references are in heavy type.)